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ITHACA, NEW YORK
March, 1956
VOL. VIII FASC. VI

Bailey

GENTES HERBARUM

Art. 20. Palmæ Micronesiæ et Insularum Boninensium

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VOL. VIII ITHACA, NEW YORK FASC. VI

GENTES HERBARUM

Occasional Papers on the Kinds of Plants

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by

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and

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Published by The Bailey Hortorium
of The New York State College of Agriculture
at Cornell University

(Mailed at Ithaca Post Office to regular list)
March 15, 1956

QK
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.B16
v.8
fasc.6

129. METROXYLON AMICARUM. Truk, Caroline Islands. Photograph by James Paseur.

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ARTICLE 20.

THE PALMS OF MICRONESIA AND THE BONIN ISLANDS.

By H. E. Moore, Jr. and F. R. Fosberg

The palms of Micronesia, as of other tropical regions, are of extraordinary interest to students of floristic plant geography, vegetation, economic botany, economic entomology, and ethnology, as well as to systematists. Although they have been treated as a whole or in part by various authors, including Beccari, Burret, and Kanehira in numerous papers, there has never been adequate material for a definitive treatment. The writers of the present treatment have, likewise, been troubled by lack of sufficient and complete specimens, but they have succeeded in bringing together many more than have previously been available. In addition, one of the authors has seen almost all of the species growing in the field, while the other has studied palms of the same and related genera extensively in gardens and herbaria and had the advantage of working for several years with the late eminent student of palms, Liberty Hyde Bailey. It is felt that the account presented here will serve not only for identification and reasonable understanding of the Micronesian species but may aid materially in working out the related palms of Melanesia, New Guinea, and to some extent, those of Malaysia. In addition, the keys presented may be of some help in other tropical areas where palms are cultivated and where no systematic account has yet been provided.

Micronesia, as treated here, includes four main groups of islands located principally in the northwest quadrant of the Pacific Ocean, north of the equator and west of meridian 180°. These archipelagoes are the Marianas, the Carolines, the Marshall, and the Gilbert Islands. In addition are included several isolated islands, namely Marcus, Wake, Ocean (Banaba), and Nauru. These four, as well as the Marshalls and Gilberts, have no native palms. The coconut, however, makes up the dominant vegetation of most of them. Because the Bonin Islands are included in the tremendous entomological project of the Bishop Museum (Gressitt, J. L., Insects of Micronesia, i, 1-257, 1954), it has been thought best to consider their palms here, also, though floristically the Bonins may be considered as closely related to temperate Asia as to Micronesia. This relationship applies equally to the palms, one native species being of Asiatic affinity, the other of Micronesian.

Since the war Micronesia has been the scene of an enormous amount of scientific activity in various fields. Large scale field investigations in geology, anthropology, botany, entomology, zoology, ecology, meteor-

ology, and oceanography have been sponsored by the United States Government in cooperation with various private institutions and individuals. A few of these have contributed substantially to our knowledge of the palms. The principal collections have been made during the Micronesian Economic Survey (1946), the botanical survey of Ponape by Glassman (1949), rhinoceros beetle work by Gressitt (1952), and Pacific Vegetation Project work (1950, 1953, 1954). Several herbaria, notably those of Kyushu University, University of Tokyo, the Arnold Arboretum, the Bailey Hortorium, and the United States National Museum have very kindly permitted the use of their collections. The authors wish to express their gratitude for this privilege.

Floristically the Caroline Islands are by far the richest of the five island groups considered in native and naturalized palms, with twelve out of the fourteen species and nine out of ten genera. In the Carolines the Palau group are the home of the majority of the species, seven out of the twelve. This is in line with the distribution of other groups and of the flora as a whole. The other high islands of the Carolines, eastward, Yap, Truk, Ponape, and Kusaie have three, four, six, and three (or four), respectively. Fais has only the coconut, as do the many atolls of the Carolines (Nukuoro has one or more trees of *Metroxylon amicarum*, probably planted). The Marianas have four species, principally on Guam, and all probably introduced. It might be added that the fossil wood of a palm has been found in probably Tertiary deposits on Guam. The Bonins have three species, two of them unquestionably native. The Marshalls, the Gilberts, and the isolated islands have only the coconut or none. Of the strictly cultivated palms, the majority are planted around the Agricultural Experiment Station of Ponape; in Korror, Palaus, where the Japanese had an experiment station and small botanical garden; and in Guam, where they are frequent around dwellings.

The large proportion of endemic genera in the Palmæ as compared with practically none in other families has been the most striking characteristic of the Micronesian flora as viewed in the past. Actually, in all other vascular families there are a total of only two endemic genera currently upheld, and one at least of those, Guamia, is not very well separated from Polyalthia. Therefore, three endemics out of the seven indigenous genera of palms seemed unusual. The present study has corrected this disproportion by showing that all of these supposedly endemic genera should be united with other groups in the islands to the south. The geographical relationships of the Micronesian species are mainly with those of Melanesia and New Guinea, except for two Palauan species which are also found in the Philippines. The affinities of *Gulubia palauensis* are not clear in the present state of classification of the genus. *Metroxylon amicarum* is apparently more primitive than any of the other species in its

genus, but in habit, at least, seems to resemble more *M. vitiense*. The Livistona varieties of the Bonin and Volcano islands are apparently members of the important Asiatic element of the flora of these islands, with their relatives possibly native in the Ryukyu Islands.

In spite of the irregular distribution of palm genera and species through the islands of Micronesia and the Bonins, palms form a very important part in the vegetation of almost all the islands, being dominant over large areas. This is in large measure due to the widespread plantations and groves of coconut palms, which completely dominate most of the Micronesian atolls and low islands, and which cover significant areas of Guam, (formerly of Rota, Tinian and Saipan), the volcanoes of the northern Marianas, Palau, Yap, Truk, Ponape, Kusaie, and to some extent Nauru and Ocean islands. In Palau palms form a conspicuous element of the native forests, with Pinanga, Areca, and Heterospathe abundant on volcanic areas in the north and Gulubia on the limestone in the southern half of the group. In Truk Clinostigma is conspicuous but the native forests are so reduced at present that native palms could scarcely be regarded as numerically very significant. Old descriptions give great emphasis to groves of ivory palms (Metroxylon) just back of the beach in swampy places. These still exist to some extent. On Ponape Clinostigma and two species of Ptychosperma form almost solid palm forests in parts of the wet mountainous interior. On Kusaie they are nowhere so common. Nypa lines estuaries in all of these high Caroline Islands, also on the east coast of Guam. On the cliffs of the small block of limestone between Agaña and the Fonte River Heterospathe is an important component of the thickets. Areca is a characteristic tree of the ravine forests of southern Guam. In the Bonins Livistona locally dominates the forests, as on Chichijima behind Omura. It is said that formerly Clinostigma was likewise important, but this is no longer true, at least on Chichi-jima, the largest island.

Economically all of the palms are or were important if at all abundant. All of them provide thatch and material for plaiting and basketry. Several provide timber for at least temporary use. The terminal buds of most of them are appreciated as "palm cabbage salad." The seeds of *Metroxylon amicarum* have in the past been exported as vegetable ivory for the manufacture of buttons. The fruits of Areca are highly valued for chewing by the natives of the Marianas and western Carolines. The coconut, however, is the most remarkable economic palm of all, and certainly the principal economic plant of Micronesia. Its green fruits provide a wholesome supply of drinking water in places where good water is scarce. Its seeds furnish one of the main foods of the natives as well as the principal export product of the area. The husks furnish cordage and fuel, the endocarps utensils and fuel, the sap both nourishment for the babies and an intoxi-

cating beverage for their fathers. The terminal bud is "millionaire salad." The leaves have the same uses as those of the other palms. An understanding of the ethnology of any part of Micronesia consequently presupposes more than a casual familiarity with at least the coconut, if not with the other local species of palms. The following account may, therefore, have wider than strictly botanical interest.

SYSTEMATIC TREATMENT

Palms frequently play a prominent role as plant indicators in the determination of floristic zones and in some instances of soil types. They are not unduly difficult to identify when complete material is available but because of their often large size and periodicity of flowering and fruiting, they are not always collected in identifiable condition. The ecologist, forester, geologist, zoologist or entomologist who may associate indicator palms with his field investigations may be hampered by lack of a name to designate these important plants.

In Micronesia, the genera and their species present are sufficiently few to permit the construction of a key based on vegetative characters. It is designed to assist field workers in botanical or other sciences currently engaged in intensive field investigations in Micronesia. A more natural and reliable key based on technical characters supplements the vegetative key.

Key to vegetative material

1. Leaves palmate.
   2. Stems lacking or very short in mature individuals: panicles arising from the base. . . . . *Sabal minor* (cult.), page 478
   2. Stems present in mature individuals.
      3. Slender cæspitose palms with persistent blackish fibrous sheaths on cane-like stems and leaves divided more than three-fourths to the apex of the petiole, the segments bluntish and several-toothed at the tip. . . . . Rhapis (cult.), page 478
      3. Stout usually single-trunked palms, the leaves generally less deeply divided and with acute or bifid segments.
         4. Leaf-sheath of slender blackish fibers persisting on the trunk in a dense shaggy coat; petioles margined with very short prickles. . . . . Trachycarpus (cult.), page 478
         4. Leaf-sheath of coarse red-brown fibers or scarcely fibrous.
            5. Petioles armed with well-developed stout prickles at least toward the base or if more rarely unarmed then the leaf-segments deeply divided into slender, gracefully hanging, fringe-like tips. . . . . Livistona (cult. & native), page 432
            5. Petioles unarmed or at most slightly roughened along the margin in age.
               6. Blades of the leaves stiff and very closely pleated, the costa straight or nearly so, green but with a pale tomentum of woolly scales on the nerves below at least when young: trunks slender, not clothed with persistent petiole-bases: flowers and fruit in a compact cluster of short slender branches at the end of a long slender, closely sheathed peduncle. . . . . *Pritchardia pacifica* (cult.), page 478

6. Blades of the leaves coarsely pleated with expanded folds, the costa prominent and usually more or less curved downward toward the tip, not persistently tomentose below except sometimes on the midnerve in Latania, then the leaves glaucous or the petioles suffused with orange-red or bright yellow-green: trunks often rather stout and frequently clothed with persistent split bases of petioles below the crown or throughout when young: flowers and fruit in much ramified inflorescences.

7. Leaves green with green petioles: flowers and fruit not enclosed or sheathed by prominent bracts, borne on slender, divaricate, ultimate branches of the inflorescence.....SABAL (cult.), page 478

7. Leaves with a bluish cast or if green then with orangish or reddish very stout petioles: flowers of both sexes sheathed with prominent imbricate bracts on coarse arched inflorescences with elongate pendulous simple branches.....LATANIA (cult.), page 477

1. Leaves pinnate.

8. Vines with usually viciously prickly sheaths and leaf-tips prolonged into spiny whips, the old stems slender, flexible and often naked.....CALAMUS (cult.), page 477

8. Erect or more rarely stemless palms.

9. Blades of the leaves twice-pinnate, the pinnules broader than long, shaped like a fish-tail.....CARYOTA (cult.), page 477

9. Blades of the leaves once-pinnate, the pinnæ longer than broad.

10. Lower pinnæ stiff, sharp and spine-like.....PHŒNIX (cult.), page 478

10. Lower pinnæ not spine-like.

11. Colonial apparently stemless palms of estuarine swamps.....NYPA (native), page 475

11. Cæspitose or solitary palms with trunks developed.

12. Leaf-sheaths brilliant red.....CYRTOSTACHYS (cult.), page 477

12. Leaf-sheaths not red.

13. Sheaths of the leaves elongate, closed or with only a V-shaped sinus at the top, crowded into a columnar crownshaft or pseudo-stem below the crown: inflorescences borne below the leaves (except in Chrysalidocarpus).

14. Pinnæ with lacerate, blunt or oblique and toothed tips.

15. Pinnæ with the median and the marginal nerves strongly developed, not plicate.

16. Stems clustered.....*Ptychosperma Macarthuri* (cult.), page 478

16. Stems solitary.

17. Forest trees: seeds 5-sulcate in cross-section with homogeneous endosperm.....PTYCHOSPERMA (native), page 466

17. Cultivated trees: seeds terete in cross-section with ruminate endosperm.....ADONIDIA (cult.), page 477

15. Pinnæ with thin margins and well-developed nerves (usually 2) within the margin, more or less strongly plicate at least toward the base.

18. Pinnæ deeply lacerate at the apex, spreading gracefully from the rachis: inflorescence simply branched with flowers and fruits borne distichously on long rachillæ.....PINANGA (native), page 450

18. Pinnæ toothed but scarcely lacerate (unless frayed) at the apex, rather stiffly ascending from the rachis, the whole crown with the appearance of a feather duster: solitary pistillate flowers and fruit borne at the base of very slender rachillæ crowded with small staminate flowers in anthesis.....ARECA (cult.), page 449

14. Pinnæ with pointed apices.

19. Stems slender, clustered, the leaves usually with orange sheaths.....CHRYSALIDOCARPUS (cult.), page 477

19. Stems solitary, stoutish, the leaves usually with green sheaths.

20. Pinnæ divergent from the rachis at several angles giving the leaf a ragged appearance: mature trunk ordinarily not prominently ringed.....ROYSTONEA (cult.), page 478

20. Pinnæ divergent in a single plane from each side of the rachis.

21. Trunk very much enlarged and bottle-shaped, at least basally: leaves in three series.....MASCARENA (cult.), page 478

21. Trunk slender throughout, not bottle-shaped: leaves spirally arranged.

22. Leaves with the pinnæ spreading stiffly and at right angles from the rachis, the whole rachis sometimes becoming somewhat twisted toward the apex: trunk prominently ringed, dark-brown or black and often splitting longitudinally into corky sections.....DICTYOSPERMA (cult.), page 477

22. Leaves with the pinnæ drooping from the rachis or ascending, very closely placed and stiffish: trunks various.

23. Pinnæ drooping from the rachis: top of the sheath and upper internodes of the stem covered with glistening bluish-white waxy epidermis.....CLINOSTIGMA (native), page 458

23. Pinnæ ascending from the rachis, stiffish, closely placed and giving the crown a feather-duster appearance: sheaths and stem not glaucous-waxy.....GULUBIA (native), page 453

13. Sheaths of the leaves splitting opposite the petiole or interspersed with fibrous sheaths but never forming a columnar crownshaft below the crown: inflorescences borne among the leaves.

24. Cæspitose or colonial palms forming clumps sometimes of large size when grown naturally.

25. Petioles densely armed with stout prickles, these not borne on spiralling ridges: stems scarcely or not at all developed..SALACCA (cult.), page 478

25. Petioles unarmed or if armed then the prickles borne along low spirally arranged ridges.

26. Tips of pinnæ sharply pointed; petioles unarmed or armed with spines from spiralling ridges: palms of large size when mature..METROXYLON (cult.), page 438

26. Tips of pinnæ obliquely toothed; petioles unarmed: palms of small to moderate size.

27. Stems cane-like: pinnæ evenly narrowed to the base, not auricled, green below.....DIDYMOSPERMA (cult.), page 477

27. Stems stoutish, covered with persistent black-fibrous sheaths: pinnæ with an ear-like appendage at the base, whitish below .....*Arenga Engleri* (cult.), page 477

24. Single-stemmed palms.

28. Leaves two-ranked on opposite sides of a fiber-covered stem.....*Wallichia disticha* (cult.), page 478

28. Leaves spirally arranged, not two-ranked.

29. Trunks covered with abundant short root-spines: sheaths of the leaves irregularly and prominently ridged (sometimes armed with spines) below the petiole: fruit covered with imbricate scales.....*Metroxylon amicarum* (native), page 439

29. Trunks lacking root-spines: sheaths of the leaves not ridged.

30. Stems largely clothed with persistent black fibrous sheaths armed with long, stiff, needle-like stout fibrous spines: leaves strongly ascending, the pinnæ blunt or rounded at the tip and auricled at the base..... ..... *Arenga pinnata* (cult.), page 477

30. Stems naked or at least not clothed with spiny sheaths: leaves various but the pinnæ never auricled at the base.

    31. Margins of the pinnæ armed with minute spines and rough to the touch: leaves strongly ascending: fruit covered with imbricate scales..... ..... RAPHIA (cult.), page 478

    31. Margins of the pinnæ not armed with minute spines: leaves various but the fruit never covered with imbricate scales.

        32. Leaf-sheaths conspicuously glaucous or glaucescent below the petiole; leaves arching and twisting at the tip in the form of a cock's tail-feather, the pinnæ more or less straight from the rachis but with drooping tips: inflorescence very much branched with pea-like fruit and small flower..... HETEROSPATHE (cult. & native), page 444

        32. Leaf-sheaths not glaucous; leaves spreading or arched: inflorescences various.

            33. Leaves spreading or arched, bearing the pinnæ in a single rank on either side of the rachis; petioles smooth-margined.

                34. Petioles very stout, often yellowish, the sheaths large, fibrous and often persisting as a shag in the crown: flowers on a branched inflorescence subtended by a large woody bract: fruit very large with a thick husk..... COCOS (cult.), page 471

                34. Petioles slender, green or brownish, the sheaths not prominently fibrous nor persistent: flowers imbedded in a long stout spike or spikes subtended by papery bracts: fruit small without a thick husk..... HOWEIA (cult.), page 477

            33. Leaves spreading, bearing the pinnæ in somewhat irregular groups and divergent from the rachis at several angles so that the leaf has a ragged appearance; lower pinnæ with thick horny bases remaining as spiny processes on the rachis as the thinner tissue falls away: inflorescences large, head-like with spinose-tipped branches and borne close to the trunk..... ..... *Elaeis guineensis* (cult.), page 477

Key to flowering and fruiting material

1. Leaves induplicate in vernation with the rachis or costa extending through a terminal segment or pinna, the pinnæ or segments V-shaped at insertion.
   2. Leaves palmate or costapalmate.
      3. Dicœcious palms, the pistillate flowers larger than the staminate, solitary in the axils of large imbricate bracts along stout amentiform branches of the inflorescence, the staminate flowers several in a cincinnus subtended by closely sheathing bracts on thick strongly amentiform branches of the inflorescence ..... LATANIA, page 477
      3. Hermaphrodite or rarely dicœcious palms, the small flowers solitary or clustered in the axils of small bractlets on slender ultimate branchlets of a usually much-ramified inflorescence.
         4. Carpels distinct with short, erect or recurved distinct styles.
            5. Flowers 2 in a cluster, not dimorphic, the corolla of imbricate, usually acute petals: petiole minutely toothed along the margin: stems stout ..... TRACHYCARPUS, page 478
            5. Flowers solitary, dimorphic, the corolla of staminate flowers tubular and 3-lobed, that of pistillate flowers stipitate and tubular: petioles unarmed: stems arundinaceous ..... RHAPIS, page 478
         4. Carpels distinct or united below, always connate by the elongate erect styles.
            6. Carpels united throughout and with a columnar style, the stigmatic remains basal in fruit; fruit depressed-globose; seed dorso-ventrally compressed with excavate endosperm: flowers solitary with non-foveolate petals: petiole unarmed ..... SABAL, page 478
            6. Carpels distinct or only lightly united at the base, connate by the styles above, the stigmatic remains apical in fruit; fruit and seeds globose or nearly so, not dorso-ventrally compressed.
               7. Flowers with tubular calyx above a more or less stipe-like base, the petals flat, caducous at anthesis, lacking foveolæ on the inner surface: fruit with abortive carpels borne at the apex ..... PRITCHARDIA, page 478
               7. Flowers with distinct sepals, lacking a stipe-like base, the petals persistent, foveolate on the inner surface: fruit with abortive carpels borne at the base ..... LIVISTONA, page 432
   2. Leaves pinnate or bipinnate.
      8. Pinnæ acute, the basal ones stiff and spine-like: dicœcious polycarpic palms with inflorescences subtended by a single ancipitous spathe: petals of pistillate flowers imbricate: fruit 1-seeded, the seed with excavate endosperm ..... PHŒNIX, page 478
      8. Pinnæ obliquely præmorse at the apex, all similar and not spine-like: monœcious monocarpic palms with inflorescences subtended by several tubular-sheathing bracts: petals of pistillate flowers valvate: fruit 1-3-seeded, the seed with homogeneous or ruminate but not excavate endosperm.
         9. Leaves bipinnate: spadices once-branched with a single primary rachis: fruit generally 1-seeded; endosperm ruminate ..... CARYOTA, page 477
         9. Leaves simply pinnate: spadices generally branched, the divisions again once-branched, the central division maturing first: fruit generally 2-3-seeded; endosperm homogeneous.
            10. Staminate and pistillate flowers on separate dissimilar inflorescences; staminate flowers with tubular calyx and corolla ..... WALLICHIA, page 478
            10. Staminate and pistillate flowers in triads on the same inflorescence, the staminate precocious.
               11. Pinnæ auriculate at the base: fruit generally 3-seeded: arborescent or cæspitose large palms ..... ARENGA, page 477
               11. Pinnæ not auriculate at the base: fruit generally 2-seeded: slender cæspitose palms with cane-like stems ..... DIDYMOSPERMA, page 477

1. Leaves reduplicate in vernation with the rachis or costa continued as a filament or lacking beyond the terminal paired pinnæ or segments, the pinnæ or segments A- or M-shaped at insertion.

12. Perianth rudimentary or absent in both sexes; staminate and pistillate flowers in the same spadix, the staminate with 3 united stamens, crowded on amentiform branches below the terminal pistillate head, subtended by numerous tubular bracts: acaulescent palms of estuarine swamps, with subterranean trunks ..... NYPA, page 475

12. Perianth developed in both sexes; flowers not as above: caulescent palms.

13. Ovary and fruit covered with imbricate scales: inflorescence and its branches subtended by more or less tubular sheathing bracts.

14. Monœcious arborescent palms.

15. Ultimate divisions of the inflorescence consisting of spike-bearing branches; spikes amentiform bearing 2 externally similar flowers at every node, the staminate opening first, the pistillate with non-functional stamens opening after the staminate falls: fruit with deeply excavate but homogeneous endosperm .. METROXYLON, page 438

15. Ultimate divisions of the inflorescence consisting of spiciform flower-bearing branchlets bearing solitary pistillate flowers at the nodes below, dissimilar staminate flowers above: fruit with ruminate endosperm ..... RAPHIA, page 478

14. Diœcious climbing or stemless or short-stemmed palms.

16. Climbing palms with the leaves terminating in spinose whip-like tips ..... CALAMUS, page 477

16. Stemless or short-stemmed palms, the leaves not terminating in whip-like tips ..... SALACCA, page 478

13. Ovary and fruit not covered with imbricate scales: inflorescence subtended by 1-2 large bracts (several in Mascarena).

17. Endocarp with 3 pores above the middle or at the apex, the embryo opposite one of them.

18. Pistillate flowers subtended by a long, stout, spine-like bract: inflorescence subtended by a fibrous inner bract: fruit less than 5 cm. in diameter, with fleshy mesocarp: petioles armed at the base with spine-like projections ..... ELÆIS, page 477

18. Pistillate flowers much larger than the staminate, sessile in the axil of a very small non-spinous bract: inflorescence subtended by a large woody inner bract: fruit very large, up to 25 cm. or more in diameter, with thick fibrous mesocarp: petioles unarmed ..... COCOS, page 471

17. Endocarp without pores, the embryo lacking a defined exit.

19. Inflorescence borne among the leaves, the leaf-sheaths (except in Chrysalidocarpus) open or soon splitting opposite the petiole and not forming a columnar crownshaft.

20. Flowers sunken in the branches of the inflorescence.

21. Single-stemmed palms: inflorescence of 1-8 pendulous spikes branching at the same level from a short peduncle; stamens numerous ..... HOWEIA, page 477

21. Cæspitose palms: inflorescence branching from a central rachis; stamens 6-15 ..... CYRTOSTACHYS, page 477

20. Flowers not sunken in the branches of the inflorescence.

22. Fruit with subapical stigmatic remains; seed with ruminate endosperm ..... HETEROSPATHE, page 444

22. Fruit with stigmatic remains at the base; seed with homogeneous endosperm ..... CHRYSALIDOCARPUS, page 477

19. Inflorescence borne below the leaves, the leaf-sheaths closed or splitting late and forming an elongate crownshaft below the leaves.

23. Flowers nearly alike, borne in lines of several staminate and a pistillate along the rachillæ; bracts subtending the inflorescence several ..... MASCARENA, page 478

23. Flowers dissimilar, borne in triads of 2 staminate and a pistillate or with paired or solitary staminate flowers above, never in lines; bracts of the inflorescence 1-2.

24. Pistillate flowers much larger than the staminate, solitary or few at the base of the rachillæ with or without attendant staminate flowers, the staminate flowers small, secund in pairs or solitary toward the tips of the rachillæ; ovule basal: fruit with apical stigmatic scar; endosperm ruminate: pinnæ erose-truncate at the tips.....ARECA, page 449

24. Pistillate flowers smaller than the staminate, usually borne over the lower half or the entire length of the rachillæ in triads with a staminate flower on either side.

25. Stamens numerous with stamen-filaments erect in bud: pinnæ erose-truncate or oblique at the apex.

26. Sepals of staminate flowers united at the base and with acute apices: ovule basal: fruit distichously arranged.....PINANGA, page 450

26. Sepals of staminate flowers distinct, imbricate with rounded apices: ovule attached in upper half of cell: fruit spirally or irregularly arranged.

27. Seed terete in cross-section.....ADONIDIA, page 477

27. Seed 3-5-sulcate with rounded interstices in cross-section.....PTYCHOSPERMA, page 466

25. Stamens 6 with filaments erect or inflexed at the apex in bud: pinnæ acute or bifid through fraying.

28. Inner bract of inflorescence much larger than outer, the inflorescence much ramified.....ROYSTONEA, page 478

28. Inner bract of inflorescence smaller than and included within the outer; inflorescence once- to twice-branched.

29. Fruit with lateral to nearly basal stigmatic remains: staminate flowers with imbricate sepals about half as long as the petals, stamen-filaments inflexed at apex in bud.....CLINOSTIGMA, page 458

29. Fruit with apical stigmatic remains: staminate flowers with acute sepals united at the base and not imbricate.

30. Petals of staminate flowers essentially equal, scarcely acuminate nor falcate: seed with ruminate endosperm.....DICTYOSPERMA, page 477

30. Petals of staminate flowers unequal, elongate, lanceolate, slightly acuminate and somewhat falcate: seed with homogeneous endosperm.....GULUBIA, page 453

LIVISTONA, R. Br. Prodr. Fl. Nov. Holl. 267 (1810).

Arborescent single-stemmed hermaphrodite palms with palmate leaves, the costa more or less elongate into the blade, the segments bidentate at the apex to nearly bipartite: inflorescence borne among the leaves, paniculate with a primary axis and several secondary axes, the latter again several-times branched, primary and secondary axes subtended by tubular bracts: flowers borne in clusters of several on a condensed irregular cushion, the sepals imbricate, petals valvate above a united base with slight paired depressions internally corresponding to position of anthers; stamens 6; carpels 3, free basally, united above by fused narrow portion of styles, ordinarily only one maturing into fruit, the abortive carpels basal in fruit, ovule 1 in each carpel, attached basally: fruit globose to ellipsoid or subreniform with apical stigmatic remains, the exocarp smooth, mesocarp thin, fleshy, endocarp thin, hard; seed with homogeneous endosperm irregularly involute below the raphe with intruded testa, the embryo lateral at or near the middle opposite the involution.

Livistona chinensis, (Jacq.) R. Br. ex Mart. Hist. Nat. Palm. iii, 240 (1838), 319 (1850); Becc. in Ann. Roy. Bot. Gard. Calcutta, xiii, 60 (1931); Nakai, in Journ. Jap. Bot. xi, 117-224 (1935). Fig. 130.

Latania chinensis, Jacq. Fragm. Bot. 16, t. 11, fig. 1 (1809).

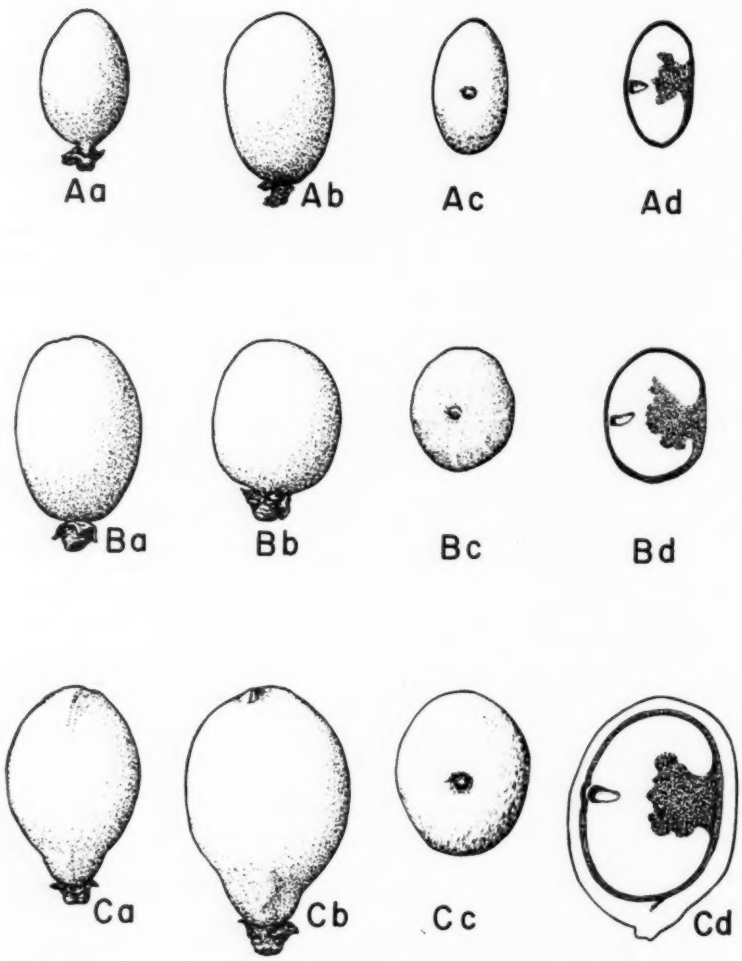
Trunks to 15 m. but trees flowering and fruiting while still very young: leaves large, the petiole armed with stout prickles at least below or more rarely smooth, blades to 1.5 m. long, divided about to the middle or below into numerous 1-nerved segments, the latter again deeply bifid with the slender tips drooping in a graceful fringe: inflorescence to 1 m. long or more, the bracts at first densely pale lepidote-tomentose becoming glabrate in some varieties, branches and their subtending bracts nearly enclosed within the primary bracts or definitely exserted, branches 2-3-times ramified: flowers ca. 2 mm. long, yellowish, about 5 to a cluster: fruit ellipsoid to subglobose or pyriform, blue-green to bright green darkening in age, 15-26 mm. long, 9-18 mm. wide; seed ellipsoid to subglobose.

Livistona chinensis as understood in this paper is a species embracing three described varieties and a probable fourth, known only from fragmentary material, as yet undescribed. The typical variety with ellipsoid fruit was described from cultivated material and today is widely grown as an ornamental in the tropics of both hemispheres. Its nativity remains in question. Beccari (1931) proposed the southern provinces of China as the possible place of origin rather than Szechwan as suggested by Martius but undisputed collections from the wild have apparently not been made.

A second variety, var. *subglobosa,* is distinguished chiefly by the larger usually subglobose fruit. It frequently occurs in cultivation in both hemispheres and in Micronesia has been collected at Merizo, Guam, *Fosberg 35668* (US, BH)* and in the Bonins at Okumura, Chichi-jima, November 14, 1935, *Tuyama* (TI); Kiyose, Chichi-jima, November 11, 1935, *Okabe* (TI, in part), in each case cultivated. Its place of origin, however, has been ascribed to the Ryukyu Islands by Beccari. Specimens have been seen from Okinawa, Iriomote and Aharem where it is said to have been abundant formerly. Its additional occurrence on islands adjacent to Shikoku, on those near Kyushu in Japan, and on Kisanto near Formosa has been reported by Nakai (1935, p. 224).

Whether it is actually native or whether it has become naturalized from introduced material requires further investigation as does the validity of its status as a variety. Martius (1850) and Nakai (1935, p. 223) have treated it as a species. It is definitely associated with *L. chinensis* and is here maintained in varietal status. Since it is principally known in culti-

* In citations of herbarium material the following herbarium abbreviations are used in accord with the list by Lanjouw and Stafleu, Index Herbariorum ed. 2, 1953: FU, Kyushu University; TI, University of Tokyo; BISH, B. P. Bishop Museum; A, Arnold Arboretum; BH, Bailey Hortorium; US, U. S. National Herbarium.



130. LIVISTONA CHINENSIS. A, var. CHINENSIS; Aa, fruit ×1 (*Nur. s.n.*, BH); Ab, fruit ×1; Ac, seed ×1; Ad, seed in vertical section ×1 (*Moore 6030*, BH). B, var. SUBGLOBOSA; Ba, fruit ×1 (*Walker 7636*, US); Bb, fruit ×1; Bc, seed ×1; Bd, seed in vertical section ×1 (*Wilson 8164*, US). C, var. BONINENSIS; Ca, fruit ×1 (*Tuyama*, November 29, 1935, TI); Cb, fruit ×1; Cc, seed ×1; Cd, fruit in vertical section ×1 (*Tuyama*, November-December 1935, TI).

vation and its original range is as yet unknown, it is not clear whether it can be regarded as a geographical variety or whether it is of horticultural origin.

Plants of undoubted wild status occur in the Bonin Islands and in the Volcano Islands. Material from both these island groups is distinguishable from *L. chinensis* var. *chinensis* and var. *subglobosa* by the less congested panicles with bracts having a deciduous tomentum and becoming nearly or quite glabrous at anthesis and in fruit. These bracts are more slender on the primary axis, more slender and more strongly exserted where they sheath the longer-pedunculate branches of the panicle. Fruit is of two types. On the fragmentary single specimen from Kita-Iwoto in the Volcano Islands (*Tuyama s.n.*, July 25, 1933, TI) consisting of a portion of a fruiting panicle only, the secondary bracts subtending branches of the panicle are produced in a compressed elongate ensiform terminal appendage and the fruits are subglobose, flattened on one side. In the Bonin Island material, var. *boninensis*, the dry fruit when mature is of a bright green color, appearing painted, larger in size and with decidedly narrowed base (Fig. 130). The three named varieties and the probable variety from the Volcano Islands are differentiated by the following key. A complete description is given only for the variety native in the Bonin Islands.

1. Bracts of the inflorescence densely and persistently lepidote-tomentose; peduncle of inflorescence-branches and subtending bracts little or not exserted from the primary bracts: fruit ellipsoid to subglobose, 15-20-(22) mm. long, 9-16 mm. wide, blue-green when mature.
   2. Fruit and seed ellipsoid, the fruit 15-20 mm. long, 9-11 mm. wide, usually tardily deciduous and then falling with the cupular perianth adherent (Fig. 130A) ..... var. *chinensis*
   2. Fruit and seed subglobose, the fruit 18-20-(22) mm. long, 14-16 mm. wide, often falling free from the cupular perianth (Fig. 130B) ..... var. *subglobosa*
1. Bracts of the inflorescence with a deciduous tomentum, becoming glabrous or nearly so at anthesis; peduncle of the inflorescence-branches and subtending bracts prominently exserted from the primary bracts.
   3. Fruit with narrowed base, 20-26 mm. long, 15-17 mm. wide: secondary bracts of inflorescence not attenuate (Fig. 130C) ..... var. *boninensis*
   3. Fruit subglobose, flattened on one side, (18)-20-22 mm. long, (15)-17-19 mm. wide, (13)-14-15 mm. thick; secondary bracts of inflorescence attenuate in a compressed ensiform appendage ..... var. ?

Livistona chinensis var. **boninensis,** Becc. in Webbia, v, 12 (1912) & ex Martelli, in Ann. Roy. Bot. Gard. Calcutta, xiii, 62 (1931).

Livistona boninensis, (Becc.) Nakai, in Journ. Jap. Bot. xi, 222 (1935). Mentioned as *Livistona chinensis* by Matsumura, Ind. Pl. Jap. ii (i), 167 (1905); Hattori, in Journ. Coll. Sci. Imp. Univ. Tokyo, xxiii (10), 21, 22, 44, pl. III, IV (1908); and Wils. in Journ. Arnold Arb. i, 102, 109, 110 (1919). Mentioned as "fan-palms" by Beechey, in Voy. Pac. Ber. Str. 515, (1831), and as "fan-palm, *Corypha japonica*?" by Kittlitz, in Twenty-four views Veg. Pac. 48 and 51 (1861).

Trunk slender, up to 20 m. tall, becoming smooth and longitudinally fissured, with leaf-scars 1-4 cm. apart, closer at top of trunk, becoming obscure with age: leaves numerous, essentially glabrous and glossy; bases of petioles expanded into a thin sheath which breaks down into conspicuous "cloth-like" interlocking cross fibers, petioles up to 120 cm. long, flat to slightly concave on top, margins ranging from smooth to spiny the whole length or part way from about 25-30 cm. above base with strong backward-pointing blackish broad-based prickles about 10 mm. or usually less long, these usually diminishing distally, hastula rounded to obtuse or slightly produced, blade with costa up to 32 cm. long, divided about two-thirds to base into about 55-82 segments, these bifid for 23-40 cm., about 3.5 cm. wide at base of divisions: inflorescence to 1 m. long or more, lowermost node with a tubular bract but no branch, second node bearing a bract and a primary branch which is fused with internode above it for two-thirds the length of the internode then free, enclosed for some distance in the bract, third node also bearing a bract and a branch which is similarly fused with its internode for most of its length; each branch, including terminal one, bears an exserted cylindrical bract at its first node, the branches then ramify producing 16-18 primary branchlets, the lower ones branching 3 times, yielding a much ramified panicle the primary branches of which are subtended by a U-shaped very low narrow scar-like ridge, possibly marking the position of an ancestral bractlet; main ramifications of inflorescence distichously arranged, ultimate ones becoming slightly irregular or spiral, ultimate rachillæ 4-10 cm. long the bracts lepidote-tomentose when young but becoming glabrate to glabrous at anthesis: flowers borne in clusters of about 5 on a condensed irregular cushion appearing somewhat like an extremely condensed scorpioid cymule, each subtended by a scale-like bractlet, apparently maturing at different times; sepals imbricate, rounded, 1.5 mm. high, slightly united at base; petals 2 mm. long, ovate, acutish; stamens 6, filaments rectangular, united with each other and with corolla in lower half, 1.2 mm. high, 0.6 mm. wide, free portion broad, 0.4 mm. high, thick, almost square, shouldered, abruptly narrowed above to a slender subulate point 0.2 mm. long, anthers broadly ovate-oblong, as broad as long, basifixed, auriculate at base, rounded at top, 0.5 mm. across; carpels 3, obovoid-angular, straight on inner faces, grooved above, free basally, united by fused narrowed portion of styles 0.2 mm. long, stigma punctiform: fruit more or less globose but with narrowed base when dry, rounded at apex, 19-26 mm. long, 15-18 mm. wide, 14-16 mm. thick when dry; exocarp smooth, drying minutely rugulose, often a bright green as though painted; mesocarp thin, fleshy, not fibrous but with several layers of blackish sclerosomes; endocarp hard, thin, more or less abruptly and sharply acuminate at base, but some scarcely showing this character; seed almost globose, slightly compressed, 15-16 mm. long, 12-14 mm. wide, 11.5-13 mm. thick, vascular strands not apparent in seed-coat, endosperm homogeneous, hard, involute on one side to half its diameter, intrusion hard, irregularly mushroom-shaped, of consistency of seed-coat, embryo lateral at or near middle and opposite the involution.

Bonin Islands (Ogasawara Archipelago): s.l., s. coll. (TI, 4 sheets); s.l., September 1919, *Miyoshi* (TI); s.l., November-December 1935,

T. Tuyama (TI); s.l., July 1920, *T. Nakai* (TI, 2 sheets). Chichijima (Titizima) Group: s.l., November 7, 18. ., s. coll. (TI). Chichijima, mountains east of bay, above reservoir, 175 m., February 13-14, 1950, *Fosberg 31545*, *31546*, *31547*, *31548*, (BH, US); slopes of mountain back of Omura, 75-150 m., February 11-14, 1950, *Fosberg 31470* (BH, BISH, US), *31470a* (US); Kitabukurozawa, July 22, 1905, *H. Hattori* (TI); Kiyose, November 11, 1935, *M. Okabe* (TI); Kiyose, November 11, 1935, *Tuyama* (TI); Kiyose, November 14, 1935, *Tuyama* (TI); Ani-jima, December 11, 1935, *Tuyama* (TI, 2 sheets); Muko-jima, December 5, 1935, *Tuyama* (TI), April 10, 1936, *Tuyama* (TI); Muko-jima orientalis, December 6, 1935, *Tuyama* (TI). Haha-jima Group: s.l., July 1932, *Tuyama* (TI); Haha-jima, April 23, 1917, *Wilson 8271* (A, 17 sheets, type; US, 4 sheets, isotype); Mei-jima, Kitamura, Byôho, November 29, 1935, *Tuyama* (TI); Hunaki-yama, November 30, 1935, *Tuyama* (TI); Yokoyama, November 25, 1935, *Tuyama* (TI); Mukō-jima, November 25, 1935, *Tuyama* (TI, 4 sheets). Mukō-jima, August 5, 1905, *Hattori* (TI); Okimura, June 27, 1920, *Nakai* (TI); Hyogidaira, October 13, 1935, *M. Okabe* (TI).

Volcano Islands (Iwo-jima), Moto-yama (Genzan), April 1934, *T. Nakai & F. Maekawa* (TI, 4 sheets). These sheets are marked cultivated. Since they clearly represent the Bonin Island form the plants were probably brought from the Bonins by Japanese colonists.

This tree, called "cabbage palm" by the local inhabitants, is a conspicuous element in the forests on the hills of Chichi-jima and other islands of the Bonin Group, where it stands out because of its light green color against the dark green of the forests. Excellent stands may be seen on the steep slopes behind Omura, the principal village.

Perplexing variation was observed in the prickliness of the petiole margins. Trees with completely smooth margins are common as are those with prickles the entire length and intermediate ones with prickles extending various distances from the base. There is some apparent variation even on one tree, but not much. No correlation of these characters with others, nor with habitat or distribution, was discerned.

The variety has been briefly mentioned and well illustrated as *L. chinensis* by Hattori (1908). Excellent habit photographs appear in his plates III and IV. It should be noted that legends for plates II and IV of the article have been reversed.

Beccari's earliest description of this variety appeared in an analytic key to species of the genus Livistona; there and in the later amplified description in Annals of the Royal Botanic Garden, Calcutta, the fruit is

described as globose or only slightly longer than wide. No type is cited in the first reference but *Wilson 8271* at the Arnold Arboretum was cited in the second and must be accepted as type since the Warburg specimen also mentioned lacked fruit. The fruits on this collection are uniformly similar to those on all of the material of var. *boninensis* cited here, with the prolonged base. The description above and that given by Nakai, therefore, more truly represent the shape of var. *boninensis*.

METROXYLON, Rottb. in Nye Saml. Kongelige Danske Vidensk. Selsk. Skrift. ii, 527, t. I (1783); Becc. in Ann. Roy. Bot. Gard. Calcutta, xii (3), 156 (1918).

Sagus, Blume, in Rumphia, ii, 146 (1843?).

Cœlococcus, Wendl. in Bonplandia, x, 199 (1862).

Arborescent, single-stemmed or cæspitose, more or less spinose, polycarpic or more usually monocarpic monœcious palms with large pinnate leaves, the petiole channelled above, smooth or with low spiralling or irregularly transverse ridges, these often prickly: inflorescence of axillary panicles of spikes or more usually of a large and terminal panicle of spikes, primary and secondary axes subtended by tubular sheathing bracts, secondary axes branched into amentiform spikes bearing externally similar but functionally staminate and pistillate bracteolate flowers in pairs spirally arranged in the axils of broad membranous more or less connate bracts: flowers with tubular 3-lobed calyx and petals valvate above a short tube, the staminate with 6 stamens, filaments united with each other and with the corolla at base, pistillode minute, trifid, the pistillate opening after the staminate have fallen, with sterile stamens little or not reduced and unilocular ovary with 3 basal erect ovules: fruit globose or turbinate, covered with imbricated scales, the mesocarp pithy without fibers, endocarp thin, brittle; seed solitary, globose, basally attached with testa involute, sometimes very deeply so, within the homogeneous endosperm, embryo basal.

Metroxylon was interpreted by Beccari (1918) as a genus of monocarpic palms having a terminal inflorescence. The inflorescence of *M. amicarum* was considered terminal "but apparently . . . not so high as in *M. Rumphii*, *M. Sagus*, *M. vitiense*, etc., but is equally composed of several partial spadices, each of which issues from the axilla of one of the uppermost leaves. The leaves evidently persist on the plant to complete maturity of the fruits, which hang in clusters from among the leaves. . . . otherwise the inflorescence is terminal and has exactly the same structure as that of *M. Rumphii*, *M. Sagus*, etc., . . ."

Further observation in the field shows that this species is not monocarpic as are others of the genus and that the inflorescence is not terminal. Panicles appear in the axils of the lower leaves (Fig. 129), persisting as old stubs even after the fruit has fallen. Mr. J. Paseur (letter to F. R.

Fosberg dated July 13, 1955) describes the species on Truk as follows: "The ivory nut palm starts fruiting when the fruiting part of the palm is about 8 or 10 feet above the soil, and continues to fruit during entire life of tree. The flower cluster forms above the lower fronds and the mature nut clusters normally hang below the fronds. The Trukese name for the ivory nut palm is 'rupung.' The average life span of the ivory nut palm is not known, however some of the tall plants on Moen are reportedly more than 20 years of age." On Ponape the species reaches a height of about 175 feet according to Glassman (1952).

Metroxylon amicarum agrees with the circumscription of Metroxylon in all respects save those of inflorescence and polycarpic habit. It may well be considered to represent the primitive type of the genus, other species of which have become highly specialized with regard to the inflorescence. The generic description, therefore, has been emended to incorporate the more complete description of the inflorescence.

Metroxylon amicarum, (Wendl.) Becc. in Ann. Roy. Bot. Gard. Calcutta, xii (3), 187 (1918). Figs. 129, 131, 132.

Sagus amicarum, Wendl. in Bot. Zeit. xxxvi, 115 (1878).

Cælococcus amicarum, (Wendl.) Warb. in Berich. Deutsch. Bot. Ges. xiv, 140 (1896) (possibly this combination should be ascribed to Wight, as Warburg did not accept it, though he made it); Wight, in Safford, Contr. U.S. Nat. Herb. ix, 244 (1905); Merr. in Phil. Journ. Sci. Bot. ix, 63 (1914); Koidzumi, in Journ. Jap. Bot. i, 141 (1917); Kanehira, in Bot. Mag. Tokyo, xlv, 274 (1931), Fl. Micr. 74 pl. 13 (1933), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 283 (1935), in Journ. Jap. Bot. xii, 635 (1936); Hosokawa, in Yamamoto, Mat. Fl. Formosa Micr. p. 36 [Taihoku, 1936], in Journ. Jap. Bot. xiii, 194 (1937), in Kudoa, v, 87 (1937), in Bull. Biogeogr. Soc. Jap. vii, 184 (1937); Bryan, in Guam Recorder, xvi (6), 22 (1939); Glassman, in Bull. Bernice P. Bishop Mus. 209, 110 (1952).

Cælococcus carolinensis, Dingl. in Bot. Centralbl. xxxii, 349 (1887); Warb. in Berich. Deutsch. Bot. Ges. xiv, 133-144 (1896); Volkens, in Engler Bot. Jahrb. xxxi, 419 (1901).

Metroxylon carolinense, (Dingl.) Becc. in Denkschriften der Kaiserlich. Akad. Wissenschaft. Math. Naturw. Klasse, Wien, lxxxix, 502, f. 5a, 5d (1914).

Metroxylon amicarum var. *commune*, Becc. in Ann. Roy. Bot. Gard. Calcutta, xii (2), 188, 189 (1918).

Metroxylon amicarum var. *majus*, Becc. op. cit. 188, 191.

131. METROXYLON AMICARUM, showing axillary fruiting panicles and some persistent remains of old panicles. Photograph by James Paseur.

Robust tree up to 20 m. (or 55 m. according to Glassman) high, trunk 35-40 cm. in diameter, brown-corky externally and beset with small stiff spinescent incipient roots about 1 cm. long, scattered 1-2 cm. apart, wood hard toward outside, pithy but fibrous within, upper part of trunk with stubs of old inflorescences, flowering panicles among leaves, those with mature fruit below leaves: leaves 5 m. long, straight, with about 85 pinnæ on each side of a strong woody rachis, this concave above, convex below; petiole 25 cm. long (22 cm. more on one side), expanding below into a sheath about 90 cm. long, closed in its lower 30 cm., transversally marked dorsally outside by curious broken irregular wart-like ridges averaging 3 cm. apart, these (in Ponape specimen) with a few strongly reflexed slender stiff spines up to 2 cm. long, outside of sheath closely lepidote, scales white-woolly when young; pinnæ linear-lanceolate, acuminate, glabrous with one strong midrib, many secondary nerves of varying strength, connected by cross veining, spaces between secondary nerves filled by very fine minor veins, pinnæ somewhat irregularly close set, alternate to subopposite and somewhat grouped in 2's, 3's and 4's especially in lower and middle part of leaf, opposite distally, apical pinnæ to 56 cm. long, 4.3 cm. wide, median 110 cm. long, 10 cm. wide, lower 80 cm. long, 6 cm. wide, lowermost 35 cm. long, 3.5 cm. wide, distributed farther down the petiole on one side than on the other: inflorescences axillary, each a complex panicle of spikes, to 125 cm. long, with about 12 primary branches, the lowest ones not developing (or else developing much later than others), each branch subtended by a bract that is tubular and sheathing at base, lower ones closed for about 15 cm. with boat-shaped limb, somewhat compressed, sinus on one side deeply V-shaped, edges thin, the free part opposite sinus acuminate, externally lepidote with close brown peltate subpersistent scales not woolly on margins, infolded bract open on the side away from the subtending bract, this thickly covered by closely appressed peltate scales; lower well-developed branches bearing 6 thick finger-like spikes of closely packed flowers, each spike subtended by 2 bracts, one at base of the 2.5 cm. long peduncle 6.5 cm. long, tubular in its lower 4.5 cm., the other at summit of peduncle 2 cm. long, tubular in lower cm., spike about 10-14 cm. long, terminated by a spinescent scaly excurrent sterile portion; at staminate anthesis spikes are 2-2.2-(3.5) cm. thick, bearing 15 spiral rows of staminate flowers closely packed together, later followed by an equivalent number of pistillate ones, the staminate and pistillate in pairs; each staminate-pistillate pair subtended by a broad horizontal plane bract, and closely surrounded by 2-5 thin membranous bractlets variously united, and closely packed with several dense tufts of hair attached basally among the bractlets; staminate flowers oblong-ellipsoidal, 8-9-(12) mm. long, calyx united one-half to three-fourths of length, 5 mm. long, lobes rounded, appressed to petals, soon splitting along sutures, petals valvate, 7 mm. long, 3 mm. wide, stamens 6, filaments thick, lanceolate, their bases fused into a cup 1.5 mm. high, which is adnate to the bases of the petals, free part of filament 4 mm. long, not inflexed at tip, anthers basifixed, 5-5.5 mm. long, strongly and unequally auriculate at base, cells produced beyond connective into a shortly bifid tip, pistillode minute, columnar-ovoid, 1.2 mm. long, trifid into oblong lobes for half its length, arising from bottom of cup; pistillate flowers similar externally to staminate flowers, sterile stamens similar to stamens of staminate flowers, of

132. METROXYLON AMICARUM, showing axillary inflorescences.

similar size, similarly fused at base into a cup, anthers without pollen, ovary broadly ovoid, slightly trigonous, covered externally by retrorse imbricate scales with erose denticulate to ciliolate margins, produced into a slender, angled or striate, subulate style 5 mm. long, its angles minutely retrorse scaberulous, apex deeply and irregularly trifid, locule one, with 3 basal erect ovules: fruit 7-11-(13) cm. high, 8-9.5-(12) cm. wide, massive, irregularly ovoid, cordate at base, obtuse and slightly asymmetric at apex which bears a prominent tubercle, exocarp covered by 24-28 rows of hard shiny closely appressed retrorse imbricate scales, these broadly triangular, apex somewhat acuminate, base rounded, up to almost 2 cm. wide, 12 mm. high, with a broad shallow median longitudinal groove, mesocarp varying from 3 to 10 mm. thick, hard pithy without obvious fibers, rigid, endocarp very thin, brittle; seed attached basally, endosperm hard, homogeneous, more or less spherical, but with one side invaginate to form a thick cup-like shape, the invagination filled with soft tissue, seed loose in mature dry fruit.

Caroline Islands. Truk: January 1915, *Koidzumi* (TI, 2 sheets); east side of Fefan Island, Mesa Village, 1 m., May 27, 1946, *Fosberg 24522* (BH, BISH, US). Ponape: Colonia, August 20, 1929, *Kanehira 879* (FU); Tolun Nanket, mountain above Nanipil, drainage of Tawenjokola River, Not Distr. 500 m., August 13, 1946, *Fosberg 26452* (BH, US). Nukuoro Atoll: Nukuoro (Matakena) Islet, 1-2 m., August 6, 1946, *Fosberg 26236* (BH, US), *Niering 731* (US).

Marianas Islands. Guam: s.l., *G.E.S. 257* (US).

This palm is native only on Ponape and Truk, high islands of the central Carolines, but has been carried to Nukuoro, an atoll south of Ponape, and to Guam and planted. Hosokawa (1936) also records it from Kusaie.

It is suggested by Volkens (1901) that it has been brought to Truk. This is possible, as it is found in the coastal strip in Truk, in swampy places back of the beach, while on Ponape it occurs high in the mountains (Fosberg) and in deep valleys (Volkens).

During German and Japanese times the fruits were harvested, dried, and the endosperm exported as vegetable ivory for use in the manufacture of buttons. The native name on Truk is "Hibun" or "Rubun" (Kanehira) and on Ponape "Os" (Glassman) or "Nioshi" (Wong). It is no longer an item of commercial importance.

Beccari differentiated two varieties based on size of pinnæ, flowers and fruit: var. *commune* (= var. *amicarum*) represents the typical state of the species with pinnæ about 6 cm. broad, spikes in fully developed bud 2.2 cm. in diameter, flowers 8-8.5 mm. long, fruit slightly broader than high, 8-9 cm. in diameter; var. *majus* has pinnæ 10 cm. broad, spikes 3.5 cm. in diameter, flowers 12 mm. long and fruit slightly longer than broad, 11-13 cm. high, 10.5-12 cm. in diameter.

All material seen, both from the wild and cultivated (Singapore), falls within the limits of var. *amicarum* though some fruits approach those of var. *majus* in size. Beccari indicated that the type specimen of the latter from Ponape was probably from a cultivated plant, and that the fruits, chosen from among some thousands, represent the extreme in size. He further suggested that the local inhabitants distinguish varieties by breadth of pinnæ but not by size of fruit. It will be noted that both minimum and maximum breadth of pinnæ occur in collections described for which detailed measurements are provided here. In view of the expected variation in a species where economic forces must have tended to cause selection of more robust plants in cultivation, the two varieties are not maintained in this paper.

HETEROSPATHE, Scheff. in Ann. Jard. Bot. Buitenzorg, i, 141 (1876); Becc. in Pomona Coll. Journ. Econ. Bot. ii, 351 (1912); Burret, in Engler Bot. Jahrb. lxiii, 72 (1929).

Arborescent single-stemmed monœcious palms with regularly pinnate leaves, the sheaths not closed nor forming a crownshaft, the acute pinnæ reduplicate in vernation: inflorescences interfoliar, much-ramified, subtended by a short outer bract and an elongate caducous inner bract, the inner inserted well above the outer: flowers in triads or rarely paired, the staminate with imbricate rounded sepals, valvate ovate petals, 6 stamens having the filaments inflexed at the apex in bud and a truncate pistillode; the pistillate with imbricate sepals and petals imbricate at base, umbonate and subvalvate apically, staminodes 3, ovary unilocular with ovule attached high in the cell: fruit small, subspherical, with subapical stigmatic remains, exocarp thin, smooth, mesocarp thin with anastomosing fibers, endocarp cartilaginous-membranous; seed globose with ruminate endosperm.

Selection of the proper name for the species of Heterospathe widely cultivated as an ornamental in the tropics of both hemispheres poses a problem. When Scheffer described the genus, he included in it a single species, *H. elata*, described from plants cultivated at Buitenzorg but said to have come originally from Amboina. The species is now known from the Philippines, Guam, Palau (var.), and the Moluccas. Beccari (1912) and Burret (1929) have equated *Euterpe pisifera*, Gaertn. with Scheffer's species. If this is so then the name *Heterospathe pisifera* should supplant *H. elata*.

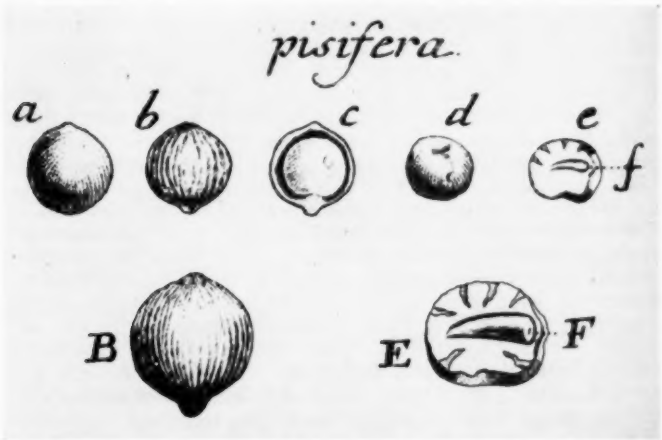
There are, however, reasons for questioning such an equation. The genus Euterpe originally included two species both described from fruits alone illustrated in De Fructibus et Seminibus Plantarum i, t. 9, fig. 3 (1788). Gaertner added a variety β to the latter in the second volume of his work 269, t. 139, fig. 4 (1791). None of these three has been considered congeneric by most palm students. *Euterpe globosa* has been selected as type of the genus by both Beccari and Burret. It has generally

been considered to represent an American palm but whatever its application it clearly has no relation to Heterospathe nor does *E. pisifera* β (written *E. pisifera* B. by Beccari thus apparently accounting for Burret's otherwise inexplicable exclusion of Gaertner's t. 9, fig. 3 B which he referred to *Dictyosperma rubrum* in place of t. 139, fig. 4).

Beccari commented on *E. pisifera* ". . . ; but in this I recognize now, with scarcely a shade of doubt, the *Heterospathe elata* Scheff., a palm common in the Moluccas and the Philippines, and in the *E. pisifera* B (β) the *Dictyosperma rubra*. . . ." Burret noted in making a formal transfer "Der von Beccari . . . geäusserten Ansicht schliesse ich mich an, die Identität halte ich für zweifellos, besonders nachdem ich authentisches Material gesehen habe." What the authentic material consisted of is not stated.

A careful comparison of Gaertner's description and figure (here reproduced as Fig. 133) with mature fruit of *Heterospathe elata* from several botanical gardens and with fruit of wild specimens from Palau (Fig. 134) shows some discrepancies.

Euterpe pisifera	*Heterospathe elata*
fruit spherical produced in an apical point	fruit almost spherical with an excentric subapical stigmatic residue
endocarp deep castaneous	endocarp yellow to yellow-brown
seed pale yellow	seed dark brown
embryo horizontal, slightly more than half the diameter of the seed.	embryo exactly basal, much less than half the length of the seed.



133. EUTERPE PISIFERA from Gaertner's De Fructibus et Seminibus Plantarum, i, t. 9, fig. 3. a, fruit, half size; b, fruit showing the fibers underneath the exterior; c, longitudinal section, showing the seed in natural position; d, seed inverted to show the umbilicus (raphe); e, albumen in vertical section; f, embryo in position, natural size. E, albumen and embryo enlarged.

134. HETEROSPATHE ELATA. a, fruit ×1; b, fruit ×2; c, fruit with exocarp and flesh of mesocarp removed to show fibers; d, seed ×2; e, fruit in vertical section with basal embryo ×2.

There are resemblances in size, structure of exocarp, mesocarp and endocarp, shape and rumination of endosperm. The position and size of the embryo, however, are at such variance with those of *Heterospathe elata* that it does not seem advisable to replace a well established name with one of such doubtful application unless it can be shown that Gaertner's description and illustration differed from the actual material studied by him.

Heterospathe elata, Scheff. in Ann. Jard. Bot. Buitenzorg, i, 162 (1876). Fig. 134.

Tree up to 16 m. tall, trunk 1-20 cm. in diameter, thicker near base, smooth, leaf-scars visible near top and 3-6 cm. apart: leaves to 3.5 m. long, pinnæ distichous on rachis, rachis arching gracefully and twisting through about 90° distally, about 65 pinnæ to a side; sheaths very glaucous externally, thickly dotted with brown scales, surrounding trunk at base, sinus V-shaped, edges fibrous, whole sheath 60-75 cm. long; petiole 48-55 cm. long, concave above, convex below, nearly smooth, sparsely lepidote; pinnæ opposite to alternate, evenly spaced, but space decreasing somewhat distally, the terminal 23 cm. long, 0.6 cm. wide, middle 60 cm. long, 3.5 cm. wide, basal 58 cm. long, 1.8 cm. wide, attenuate to an acute apex, but this frayed very early, nerves of 5 orders, the finest extremely fine but extremely regular, the heavier ones very prominent, especially on upper surface, dark brown scales along mid-nerve above and white lepidiæ present below when leaves are young, surface when dry frequently cross rugulose: inflorescence interfoliar; peduncle compressed, 4-6 cm. long; outer bract compressed, slightly falcate, edges ancipitous, sharp or crispate, about 30-40 or more cm. long, split near the edge on inner surface but not clear to base, persistently sheathing basal internodes of panicle, bracts, at least when fresh, densely covered by closely appressed peltate brown scales with woolly fimbriate margins, darkening with age and losing woolly appearance of margin; inner bract attached 8-15 cm. above attachment of outer bract, about 70-75 cm. long, split to base, caducous, apex prolonged into a flat solid appendage up to 8 cm. long, rounded at apex; panicle up to 160 cm. long, main axis branched repeatedly, as many as fifteen times, lower branches branched two or rarely three times, rachillæ 1.5-2.5 mm. thick, almost straight, variable in length up to 20 cm. long, with a closely floccose indument when young but early glabrate; flowers in triads or

rarely pairs, roughly spirally arranged 1.5 to 2 mm. apart on rachilla, staminate at side and slightly above but closely continguous with pistillate: flowers white, the staminate with strongly imbricate rounded sepals slightly broader than high, 1.5 mm. wide, 1.2 mm. high, thickened in center with broad, pale, thinner, minutely ciliolate margin, petals valvate, ovate, concave, striate when dry, 2.2 mm. long, 1.8 mm. wide, stamens 6, very slightly exceeding petals, the subulate filaments inflexed at apex in bud, the inflexed portion filiform, anthers oblong, attached slightly below middle of the dark connective, pistillode 1.4 mm. high, 0.5 mm. thick, essentially truncate, apex slightly expanded, the margin irregularly denticulate; pistillate flowers ovoid, ca. 3 mm. long when expanded, sepals strongly imbricate, rounded, broader than high, 1.2-1.4 mm. high, closely appressed in fruit, petals to 3 mm. long, strongly imbricate basally, umbonate and not strongly imbricate at tips, obtuse and not enlarged in fruit, closely appressed to fruit forming a saucer-shaped cup, staminodes 3, usually on one side, strap-shaped, in fruit slightly broader at base, blunt at apex, tips dark or not, ovary apparently oblong-obovoid, locule in lower third, upper or stylar portion very thick, apex low-conic with curved stigmatic band, at anthesis stigma with 3 exserted recurved lobes, these bluntly ligulate with broad base to bluntly triangular, ovule pendulous attached by apical half on one side of cell: fruit white, 7.5 mm. high, 6.5 wide, almost spherical, smooth when fresh but drying papillate, stigmatic scar forming a subapical tubercle, about one-third the circumference up from base; exocarp thin, pale green or white, mesocarp thin, with a network of anastomosing fibers covering entire surface of endocarp and a heavy flat straight fiber from base to top of attachment of seed, endocarp cartilaginous-membranous; seed globose, 6 mm. diameter, attached along one side, vascular strands descending from the raphe, anastomosing, especially toward base, corresponding with grooves in surface of seed which in turn correspond with rumination of hard endosperm, embryo within base of hilum, at base of fruit.

Two varieties are recognized, one native in the Philippines and perhaps in the Moluccas but frequently cultivated elsewhere, the other native on Palau.

1. Rachillæ 2-2.5 mm. thick in fruiting condition; pinnæ not strongly cross-rugulose when dry ..... var. *elata*
1. Rachillæ 1.5 mm. thick in fruiting condition; pinnæ rather strongly cross-rugulose when dry ..... var. *palauensis*

Heterospathe elata var. **elata.**

Heterospathe elata, Scheff., l.c.; Merr. in Phil. Journ. Sci. Bot. ix, 64 (1914); Walker & Rodin, in Contr. U.S. Nat. Herb. xxx, 457 (1949).

Heterospathe elata var. *guamensis*, (Becc.) Becc. in Martelli, in Atti Soc. Tosc. Sci. Nat. Pisa Mem. xliv, 140 (1934); Martelli, in Nuov. Giorn. Bot. Ital. n.s. xli, 707 (1934).

Characterized by thicker rachillæ, 2-2.5 mm. in fruiting condition, and by scarcely prominent cross-rugulosity on pinnæ when dry.

Marianas Islands. Guam: s.l. *Guam Experiment Station 129* (US); Back road from Yona toward Ylig River, October 28, 1945, *Rodin 737* (US); Lower Fonte River, west of Agaña, 10 m., January 24, 1950, *Fosberg 31215* (BH, BISH, US); Macajna Mt., just south of Agaña, 210 m., December 16, 1953, *Fosberg 35240* (BH, US). Native name in Guam *Palma brava* according to Safford.

No significant differences are apparent between the Guam material and what little is available of Philippine origin or cultivated in various botanical gardens. This supports the idea that this plant, though wild and well established in Guam, may have been brought, possibly in historic times, from the Philippines. Significant is the fact that it is nowhere abundant except around the cliffs of the limestone block just south of Agaña and on the hills across the Fonte River from this block. In extensive field work on Guam no other locality has been recorded except that by Rodin back of Yona, where only one tree was found (Walker and Rodin, 1949).

Heterospathe elata var. **palauensis,** (Becc.) Becc. in Martelli, in Atti Soc. Tosc. Sci. Nat. Pisa Mem. n.s. xliv, 140 (1934), in Nuov. Giorn. Bot. Ital. n.s. xli, 707 (1934) as var. *palawensis* (sphalm.).

Heterospathe palauensis, Becc. in Engler Bot. Jahrb. lii, 4 (1914); Kanehira, in Journ. Jap. Bot. xii, 638 (1936), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 284 (1935).

Differs from var. *elata* in the more slender rachillæ, ca. 1.5 mm. thick, especially noticeable in fruiting condition, and in more strongly cross-rugulose pinnæ when dry.

Palau Islands: s.l. cult., II, 1915, *Koidzumi* (TI, 3 sheets). Babeldaob: west coast, Itau, first estuary south of Me'ebe'ubul, 1-10 m., March 28-30, 1950, *Fosberg 32419* (BH, US), *Fosberg 32427* (US); Aimiliik, September 22-23, 1935, *Kanehira & Okamoto 9* (FU); Aimiliik, August 1933, *Kanehira & Nisida 3439* (FU); Aimion, in monte Ngarua, September 4, 1937, *Tuyama* (TI); Arumonogui, August 1932, *Kanehira 2093* (FU); Kotchwell, September 3, 1937, *Tuyama* (TI); Ngarsul, August 23, 1937, *Hosokawa 9050* (A); Ngarsul, August 24, 1937, *Hosokawa 9053* (A); Koror, April 1938, *Kanehira & Hatusima 4373* (A, FU, 2 sheets); Koror, in collis calcareis, August 26, 1939, *Tuyama* (TI, 9 sheets); Koror, Arumidu-sangosekaiganzan, October 7, 1933, *Hosokawa 7410* (A).

Most of these collections are from volcanic soil but some are from limestone. The Fosberg collection is from wet forest.

Differences in fruit size and curvature previously used to differentiate this variety seem entirely too tenuous to be significant, and tend to dis-

appear as more material is examined. An analytical plate (in Journ. Jap. Bot. xii, 639, fig. 3, 1936) gives essential characters of the variety. Native name "Domaile" [or "Domaire"], appears on several collections by Tuyama and on the one by Kanehira and Nisida. Tuyama also records "Bugeranbegarap" on one of the same specimens that bears "Domaire." "The mailei" appearing on *Fosberg 32419* is obviously equivalent to "Domaile."

ARECA, L. Sp. Pl. Ed. 1, 1189 (1753) and Gen. Pl. Ed. 5, 496 (1754).

Small to large, cæspitose or single-trunked unarmed monœcious palms with pinnate leaves, the leaf-sheaths tardily splitting, forming an elongate crownshaft below the crown, the pinnæ reduplicate in vernation, erose-truncate at the apex: inflorescence borne below the crownshaft subtended by a single ancipitous caducous bract, much-ramified with slender ultimate rachillæ, the flowers borne in triads of 2 staminate and a pistillate at the bases of the rachillæ, paired or solitary staminate above or less frequently in triads nearly throughout: staminate flowers small with acute sepals, subsymmetric valvate petals, 3-24 stamens, the filaments erect, pistillate flowers much larger than staminate with imbricate sepals and petals, ovary unilocular with basal ovule: fruit ovate to oblong, small to medium size with apical stigmatic remains, exocarp smooth, mesocarp spongy- or fleshy-fibrous, endocarp thickish, seed with ruminate endosperm and basal embryo.

Areca Cathecu, L. Sp. Pl. Ed. 1, 1189 (1753) [commonly spelled *A. Catechu*]; Cham. Remarks and Opinions, 183 (1821); Volkens, in Engler Bot. Jahrb. xxxi, 459 (1901); Safford, in Contr. U. S. Nat. Herb. ix, 187, pl. XXXV (1905); Prowazek, Deut. Marianens, 114, 1913; Merr. in Phil. Journ. Sci. (Bot.) ix, 63 (1914); Kanehira, in Bot. Mag. Tokyo, xlv, 274 (1931), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 283 (1935), in Journ. Jap. Bot. xii, 634 (1936); Bryan, in Guam Recorder, xvi (6), 23 (1939); Glassman, in Bull. Bernice P. Bishop Mus. 209, 109 (1952).

Single-stemmed palms to 10 m. high: leaves short-petiolate, with ca. 12 pinnæ closely placed on each side of the short rachis, sheath ca. 60 cm. long, green, the pinnæ plicate at insertion with 2-3 primary nerves and blunt toothed apices, the lower to 48 cm. long, 6 cm. wide, median to 60 cm., 4.5 cm. wide, apical to 18 cm. long, 6 cm. wide: inflorescence with axis to 30 cm. long, primary branches to 30 cm. long, mostly ventral, stiff or more or less pendulous; staminate flowers 5 mm. long, pistillate flowers 1.5-2.0 cm. long, in basal half of panicle only: fruit oblong to ovoid, ca. 4 cm. long, 2-2.5 cm. diameter, dull orange to red when mature; seed subglobose ca. 1.5-2 cm. diameter, the endosperm reddish or dull yellow.

Marianas Islands. Guam: s.l. *Marche 201* (P); s.l. *G.E.S. 334* (US); near Yona, *Rodin 730A* (US, 2 sheets), *Rodin 562* (US); north slopes of Mt. Almagosa, *Fosberg 35499* (US, BH); Umatac, *Fosberg 35444* (BH, US).

Caroline Islands. Yap: Rul, Ngoluk, *Wong 439*. Palau: s.l. 1915, *Koidzumi* (TI); Babeldaob I., Ngatpang, August 15, 1939, *Tuyama* (TI, 6 sheets).

The betel-nut palm is found in the southern Marianas, with definite records only from Guam, and in the high Carolines on Ponape, Truk, Yap and Palau. In all of these islands it is planted and on Guam it has become thoroughly naturalized and is a conspicuous element of the forest vegetation in the ravines and on steep slopes in the southern volcanic half of the island. Of the occurrence on Truk J. Paseur writes (letter to F. R. Fosberg dated July 13, 1955) "A few betel nut palms were introduced on Moen and Dublon by the Saipanese prior to World War II. One or two trees are reportedly still existing on Dublon; none can be found on Moen. The native name for the betel nut is 'pu.' The Trukese do not chew the nuts."

The following vernacular names are recorded for Micronesia: Guam, "Pugua" (Safford, 1905, Merrill, 1914); Ponape, "Poc" (Glassman, 1952); Truk, "Pu" (Paseur, 1955); Yap, "Bu" (Volkens, 1901, Wong, 1951); Palau, "Bua" (Safford, 1905).

The principal local use of this palm is the well known one as a masticatory. Safford (1905, p. 177) gives an excellent account of this practice. The "nut" is the fruit, used either green or dried (commonly green in Yap and Palau, as seen by Fosberg in 1946 and 1950). In Guam, according to Safford, the fibrous mesocarp is removed. In Yap and Palau it is not. The Yapese, in addition to chewing the fruit, according to Wong use the leaf-sheath in making seating pads, cradles, bowls, and wrappings for food, the wood for house construction, and the bract to tie food and baskets.

Although wild in Guam, this tree is almost certainly of aboriginal introduction there, as in the rest of Micronesia. On Guam the natives distinguish two forms, a red and a "white." The only tangible difference is that in the red form the general color of the endosperm and especially of the ruminations and that of the cortex of the living roots is reddish, while in the "white" form they are dully yellowish. The Chamorros prefer the red form for chewing.

PINANGA, Blume, in Rumphia, ii, 76 (1838), Bull. Neerl. 1838, 65 (1838).

Pseudopinanga, Burret, in Notizbl. Bot. Gart. Berlin, xiii, 188 (1936), xv, 85 (1940).

Small to moderate, single-stemmed or cæspitose, unarmed monœcious palms with pinnate leaves, the sheaths tardily splitting, forming an elongate crownshaft below the crown, the pinnæ induplicate in vernation, several-nerved, erose-truncate or lacerate at the apex: inflorescence borne

below the leaves, subtended by a single ancipitous caducous bract, simply branched with flowers in triads often distichously arranged throughout the rachillæ: staminate flowers strongly asymmetric with short 3-lobed calyx and acute valvate petals, stamens numerous with erect filaments, pistillode lacking; pistillate flowers with imbricate or sometimes partially or completely united sepals and imbricate petals, the ovary unilocular with basal ovule: fruit ellipsoid with apical stigmatic remains, exocarp smooth, mesocarp thin, fleshy and fibrous, endocarp thin, adherent to seed; seed ellipsoid with ruminate endosperm and basal embryo.

Burret (1940) has identified the Micronesian representative of the genus Pinanga with *Pinanga insignis*, a variable species distributed on several of the Philippine Islands. This species is the type of Burret's genus Pseudopinanga, separated from Pinanga because the calyx consists of united sepals. The genus is not maintained here. Examination of pistillate flowers in all stages of growth shows significant variation in the degree of union among the sepals. Often these are entirely united in a low cup at anthesis but splitting into 3 distinct or nearly distinct members as the fertilized flower commences to enlarge. Rarely is the union retained in the fruiting stage.

Such a union is far from invariable. Many flowers have sepals partially united but show a distinct imbrication between two of them. This imbrication may be partial or essentially complete. The use of a varying single character to divide a genus that is otherwise distinctive and homogeneous serves only to obscure the essential characters of Pinanga.

Pinanga insignis, Becc. in Phil. Journ. Sci. Bot. ii, 223 (1907).

Pinanga micronesica, Kanehira, in Journ. Jap. Bot. xii, 635, figs. 1-2 (1936).

Pseudopinanga insignis, (Becc.) Burret, in Notizbl. Bot. Gart. Berlin, xiii, 194 (1936); Kanehira & Hatusima, in Bot. Mag. Tokyo, liii, 190 (1939).

Mentioned also, in error, and figured as *Glubiopsis palauensis* by Kanehira, in Fl. Micr. 76, 77, fig. 11 (1933), in Bot. Mag. Tokyo, xlv, 274 (1931), in Jour. Dept. Agr. Kyushu Imp. Univ. iv, 284 (1935).

Single-stemmed tree up to at least 6-9 m. tall, 10-25 cm. thick, leaf-scars 2-5 cm. apart, not equally spaced; inflorescences borne below a well-developed crownshaft: leaves pinnate, lamina 3 m. long, 1.5 m. wide; sheath about 75 cm. high, externally gray and striate when dry, but strongly lepidote with peltate irregularly long-fimbriate dark brown scales, interior smooth, bright castaneous, wrinkled longitudinally in drying, sinus V-shaped, margins irregular but not fibrous, about 15 cm. deep, contracted upward into a well-developed lepidote petiole, the latter concave above, convex below, changing rather abruptly to a rachis with a pronounced ridge above, the rachis densely sericeous lepidote beneath

when young, upper surface with minute white lepidæ; pinnæ essentially glabrous above, densely but minutely pale-lepidote on all nerves below when young, puncticulate with scale attachments when older, 2 strongest nerves with a single row of very closely imbricate larger peltate scales; pinnæ more or less evenly spaced in subopposite pairs, becoming closer together distally, attachment doubly plicate or M-shaped, mostly 2-costate (rarely 1- or 3-), broadly linear to linear-lanceolate, apex bifid, each main nerve running into a point, fraying into an irregularly lacerate apex, apical pinnæ up to 39 cm. long, 4 cm. wide (terminal smaller and up to 10-costate), median to 64 cm. long, 4.5 cm. wide, lower to 75-80 cm. long, 5-6 cm. wide, the usually 2 primary nerves very strongly and sharply elevated on upper surface, midrib and marginal nerves of second order, with 3 or more lesser orders of nerves irregularly developed: inflorescence a panicle 50-80 (-100) cm. long on a strongly recurved flattened peduncle up to 3 cm. long and to 5 cm. wide, usually conspicuously cross-roughened or callose; bract 1, caducous, lanceolate, strongly wing-margined, blunt, attached very close to base, scar up to 7.5 cm. from base long after bract has fallen; branches simple, 20-30 cm. long, about 4 mm. thick at base thinner toward ends, pendent from a central axis to 25 cm. long, somewhat spirally arranged, especially above, subtended by small scale-like bractlets; triads of flowers very numerous, closely spaced the entire length of branchlets, strictly distichously arranged, alternate; rachillæ in staminate condition 40 cm. long, completely covered by staminate flowers, staminate flowers caducous well before pistillate become fully developed, rachillæ elongating greatly in pistillate condition till flowers are well separated, about 26 flowers to a dm. and in fruit to 17-24 to a dm.; staminate flowers very asymmetric, crushed together into irregular curved angular shapes, roughly pyramidal, acuminate at apex, the largest flattest faces on the outer sides of the triads, the greatest length of flower 8-10 mm., with sepals fused into a very low cup with 3 sharply acute unequal lobes, the longest outward in the triad, the next toward the other staminate flower, the shortest toward the rachilla, these extremely varied in shape, the longer up to 7 mm. long, the next up to 5, the shortest up to 4.5 mm. becoming shorter distally in the inflorescence, petals sharply but shortly acuminate, strongly unequal in size and varied in shape both in same flower and from flower to flower, valvate but in some examples the longest hooking over the next, stamens about 40, shorter than petals, filaments shorter than the erect linear-oblong anthers, these 3 mm. long, very shortly auriculate at base, at apex scarcely produced beyond the dark thick connective, pistillode apparently lacking; pistillate flowers about 3 mm. high, urceolate with stigma exserted, calyx of united or partially united sepals subequal to petals, almost truncate but slightly denticulate, splitting very soon into 3 irregular segments, petals strongly imbricate, much broader than high, with fimbriate margins, especially laterally, 4 mm. wide, 2 mm. high, staminodia apparently lacking, pistil 3 mm. high, ovoid, style 1.5 mm., firm, ovary softer, 1 mm. high with a conical cell at base, filled by the basally attached ovule, stigma subcapitate, irregularly lobed and grooved: fruit red, horizontal, conspicuously distichous, symmetrical, ellipsoid, acuminate to a blunt tip at both ends, 22-23 mm. long, 11-12 mm. thick, perianth cup indurate, scarcely enlarged, persistent on rachilla, exocarp smooth, mesocarp thin, fleshy, fibrous with parallel or slightly inter-locking fibers the length of the

fruit, endocarp very thin, tightly adherent to seed; seed ellipsoidal but eccentrically depressed at base, endosperm strongly ruminate, embryo basal but slightly eccentric.

Caroline Islands. Palau Islands: s.l. August 1937, *Hosokawa 9115* (US); Aulupse'el I., just south of Koror, landlocked bay of southeast corner of island, on small area of volcanic soil, 0-5 m., March 26, 1950, *Fosberg 32373* (BH, US); Korror I., on coral rock, July 4, 1929, *Kanehira 114* (FU); Babeldaob I., Itau, first estuary south of Me'ebe'ubul, 1-10 m., March 28-30, 1950, *Fosberg 32422* (BH, US); Aimiriik, February 28, 1934, *S. Nisida (Kanehira's) 3442* (FU, type of *P. micronesica*, 3 sheets); Aimiriik, August 1932, *Kanehira 1952* (FU); Aimiriik plantation, August 28, 1937, and August 28, 1937, and August 14, 1939, *Tuyama* (TI, 3 sheets); Garumiscan, August 3 and September 1, 1937, *Tuyama* (TI, 2 sheets); Gaspan, August 5, 1939, *Tuyama* (TI); Arumonogui, near Arumatan, September 15, 1933, *Hosokawa 6764* (A).

This species is common in wet forests on volcanic soil generally, though *Kanehira 114* is labelled as from coral rock. It seems to occur in secondary as well as primary growth, generally at low altitudes.

Pinanga insignis was confused with Gulubia by Kanehira in Flora Micronesica. The error was later rectified when Kanehira described Palau trees as *Pinanga micronesica*. A detailed analytic plate and photograph of habit accompanied the description. Reduction of *P. micronesica* to *P. insignis* is based on Burret's discussion previously noted and an examination of Philippine specimens including an isotype of *P. insignis* (US).

GULUBIA, Becc. in Ann. Jard. Bot. Buitenzorg, ii, 128 (1885) [nomen], and ex Baill. Histoire des Plantes, xiii, 341 (1895); Webbia, xi, 40 (1955).

Gulubiopsis, Becc. in Engler Bot. Jahrb. lix, 11 (1924).

Single-stemmed, tall, unarmed monœcious palms with pinnate leaves, the sheaths closed, forming an elongate crownshaft below the crown, the acute pinnæ reduplicate in vernation: inflorescence several times ramified, borne below the leaves, subtended by 2 ancipitous caducous bracts, the outer enclosing the inner; flowers in triads of 2 staminate and central pistillate along the rachillæ, the staminate asymmetric with short 3-lobed calyx and acute subvalvate or precociously spreading petals, stamens 6-24 with short erect filaments and elongate anthers, pistillode minute, the pistillate conical with imbricate sepals and petals, staminodia 2-3, ovary unilocular with ovule attached in upper half of cell: fruit ellipsoid with apical stigmatic remains, exocarp thin, mesocarp thin with a single layer of flattened fibers, endocarp indurate; seed with linear attachment, homogenous endosperm and basal embryo.

Gulubiopsis was established by Beccari to include the single species *G. palauensis* which was distinguished from both Gulubia and Kentia by

the presence in the mesocarp of rigid fusiform fibers shorter than the entire length of the fruit. The most recent treatment of the genus (Beccari and Pichi-Sermolli 1955) separates it on the basis of the early expansion of staminate flowers.

Staminate flowers of the Kentieæ are remarkable for their irregularity. Petals are neither equal in size nor in shape. They are not imbricate, nor do they show the strongly valvate character of the Ptychospermeæ and some other tribes. Instead, the outer petal is usually largest and the two inner are appressed to it but with free margins. Staminate flowers of *Gulubia Brassii*, Burret, have well separated though not expanded petals in bud, although the numerous stamens have not fully developed in isotype material. The early expansion of staminate flowers in *Gulubia palauensis* is readily attributed to mechanical pressure of the anthers which are larger in relation to the petals than those of most species of Gulubia. Mature fruit of *G. palauensis* has fibers that extend the length of the fruit as well as fibers that run to the middle or beyond and there terminate. In this respect the fruit of *Gulubia Brassii* shows the same structure, while in *G. costata* much thickened fibers anastomose or disappear at the top of the fruit. The fibers of secondary size underlying them are thin and of varying length. In essential morphology there is no sound basis for the separation of Gulubiopsis and Gulubia.

Comment on the status of the generic name Gulubia is required. The name was first used by Beccari in a discussion of segregates from Kentia where he noted "Le *K. Moluccana* e *costata*, che molto si avvicinano alla *K. procera*, differiscono da questa: 1°, per la forma dei fiori ♀ e dei petali; 2°, per gli stigmi; 3°, per il rudimento degli stami; 4°, per la forma dei rami dello spadice. Ho creduto perciò conveniente per le 2 prime piante, dovere creare il nuovo nome generico *Gulubia*."

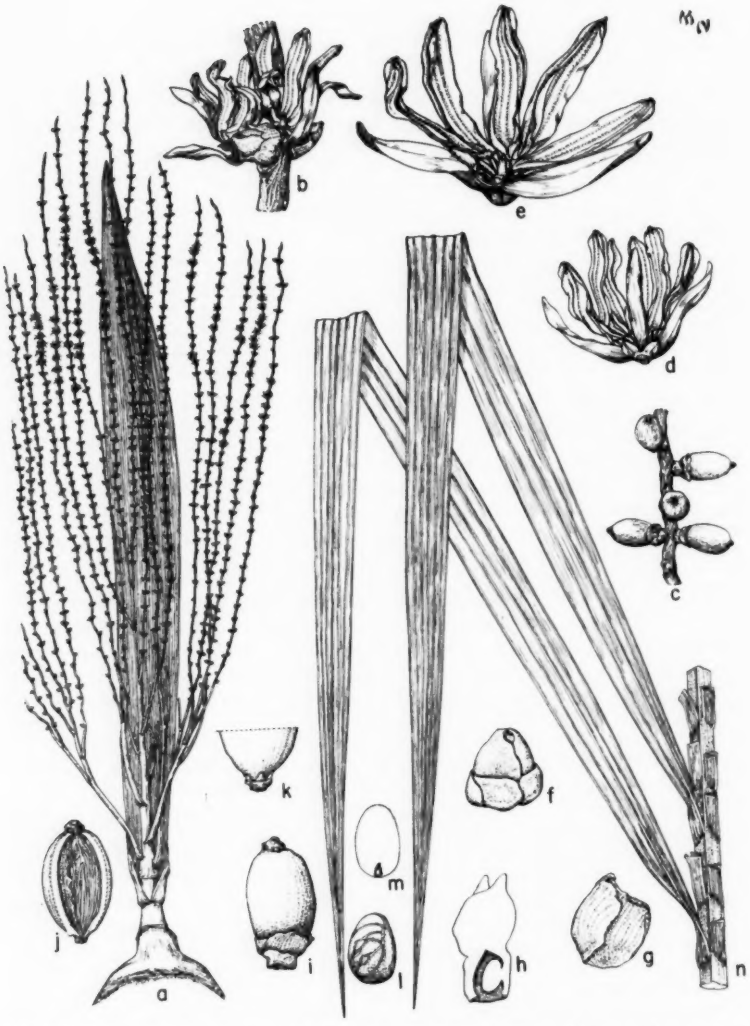
Kentia procera was described in detail followed by similarly detailed descriptions of *Gulubia moluccana* and *Gulubia costata* from which the differences noted can be ascertained more clearly. Drude, in treating the Palmæ for Die Natürliche Pflanzenfamilien (II, 3, 1-93, 1889) mentioned the several genera proposed by Beccari in Annales du Jardin Botanique de Buitenzorg only in observations under the genera Kentia, Ptychosperma and Nenga.

It remained for Baillon to provide the first legitimate description which, although brief, complied with current requirements. It should be noted that Baillon's description of valvate petals can only apply to staminate flowers or to the very tips of the pistillate petals, and his mention of ruminate endosperm is in error. There is no question as to the circumscription of the genus, however, for he lists only two species in the genus and refers directly to the detailed descriptions previously provided for these by Beccari.

† **Gulubia palauensis,** (Becc.) comb. nov. Fig. 135.

Gulubiopsis palauensis, Becc. in Engler Bot. Jahrb. lix, 11-13, fig. 133 (1924).

Tree 18 or more m. tall, trunk 15 cm. thick, wood hard externally but more or less pithy in center, leaf-scars 15 cm. apart near base, closer together upward, almost contiguous near top; panicles occupying 3 nodes immediately below the well-developed crownshaft: leaf about 175 cm. long, stiffly ascending, sheath 57 cm. long, woolly-lepidote externally, closed, with a V-shaped sinus 12 cm. deep opposite the petiole, edges slightly irregular but not fibrous; petiole 18.5 cm. long, almost flat on top, shallowly convex below; rachis about 100 cm. long, strongly and minutely lepidote with dark brown scales with whitish woolly-fimbriate margin; pinnæ long-attenuate at apex, usually frayed, about 35 on a side, alternate, the several at the base crowded together, generally pointing forward, inserted at a narrowly acute angle, the apical to 23 cm. long, 1.2 cm. wide, median 55 cm. long, 2.2 cm. wide, basal 49 cm. long, 1.4 cm. wide; nervature not very prominent, nerves of four orders, the finest occurring singly occasionally between those of the next order; lower surface puncticulate, papillose, dots dark brown, arranged along the nerves, midnerve with light brown densely white-woolly scales 3.5 mm. long, mostly attached basally: inflorescence about 55-60 (-80) cm. long; peduncle compressed, about 3 cm. long to first bract; inner bract inserted 12-13 mm. above outer, outer bract compressed, ancipitous, 49 cm. long, 5.2 cm. wide when dry, inner bract acuminate, compressed with edges rounded, 48 cm. long, 4.2 cm. wide; third incomplete bract 12 mm. above second, about 8.5 cm. long, about 1 cm. wide, strap-shaped; ramification beginning about 5 mm. above third bract, lowest branches two to three times branched, upper generally simple, primary rachis to ultimate division 15-16 cm. long above uppermost bract, individual rachillæ up to 32 (-40) cm. long, slightly undulate, thickening to 2 mm. in fruit, triads of flowers regularly decussate, opposite or subopposite, 3-9 mm. apart, continuing evenly distributed to tip of rachilla: staminate flowers white (when fresh), sepals minute ovate triangular scales 0.75 mm. long, petals elongate, lanceolate, slightly acuminate, 3.5-4 mm. long, 0.75-1 mm. wide, somewhat falcate at tips, stamens 6, filaments short, thick, roughly conical, slightly under 1 mm. long, anthers linear-oblong, tips slightly exserted beyond petals, somewhat twisted, basifixed, introrse, 4-4.5 mm. long, cells prolonged (slightly beyond connective), base unevenly auriculate, connective narrow, pistillode narrowly conical, produced slightly toward apex, apex very slightly trifid or "tripapillate," about equalling filaments; pistillate flowers 2.5 mm. long, conical in bud, sepals at anthesis 1.5 mm. long, rounded, free, imbricate in fruit, 1.4 mm. long, appressed into a short cylindric cup, very slightly constricted in the middle and very slightly flaring above, petals broad and rounded with somewhat umbonate tips, free, very slightly imbricate at tips, strongly imbricate below, at length appressed against fruit, 3 mm. long, black, staminodia 2-3, minute, ovate, 0.4 mm. long, in fruit ovate with narrowed black acute tips, 0.6 mm. long, ovary apparently globose-ovoid, with a slightly produced conical tip, actually only the lower third is proper ovary, the larger upper part a greatly thickened "style" of very firm tissue, the conical projection on top probably stigmatic, ovule pendu-



135. GULUBIA PALAUENSIS. a, panicle, staminate flowers mostly fallen, ×1/4; b, portion of rachilla with staminate and pistillate flowers ×3; c, portion of fruiting rachilla ×1; d, staminate flower ×3; e, staminate flower with pistillode exposed ×4; f, pistillate flower not fully expanded ×4; g, petal ×7; h, pistil in vertical section ×10; i, fruit ×2; j, fruit with exocarp and portion of mesocarp removed to show fibers ×2; k, staminodes in fruit ×3; l, seed ×2; m, seed in vertical section ×2; n, portion of leaf ×1/3.

lous, attached laterally along upper half or two-thirds of locule: fruit borne at right angles to rachis, ellipsoid, 9-10 mm. long, 4.5-5.5 mm. diameter, smooth when fresh, when dry gray, minutely mamillate, minutely longitudinally irregularly ribbed when dry, with terminal projecting indurate stylar portion persisting as a rounded black button-like umbo with an irregular scar in the center, exocarp thin but distinct, mesocarp thin, with one layer of closely spaced flattened fibers extending the length of the fruit, endocarp indurate elastic; seed oblong-ellipsoid, rounded at ends, 4 mm. wide, 6-6.5 mm. long, attachment linear along the length of one side, vascular strands about 4 mm. diameter, 4 on each side, descending from the raphe, appearing as whitish stripes from the white raphe back and downward to form a slight network just above and back of the circular micropyle, endosperm hard, smooth.

Endemic to Palau.

Palau Islands: Koror, in collis calcareis, *Tuyama*, August 26, 1939 (TI, 7 sheets); Koror, August 1932, *Kanehira 1904* (FU); Koror, on elevated coral rock, April 1, 1938, *Kanehira & Hatusima 4561* (FU, 2 sheets); Auloptagel I., December 1952, *Gressitt 45* (US); Urukthapel I. east end, April 2, 1950, *Fosberg 32491* (US, BH, BISH); Almezu I., August 26, 1937, *Hosokawa 9067* (A); [Kasioru, 11 April 1936, *Takamatsu 1492* fide Burret. Korror, *Ledermann 14149*, type, not seen.] Collections cited as this species, *Kanehira 114*, *1942*, and *3442*, by Kanehira, in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 284 are Pinanga. Native names: "Bugelangererals" acc. Ledermann fide Beccari; "Subiia" acc. Palauan informant Alkong (*Fosberg 32491*). The name "Akaboek" given by Kanehira (Enum. 284, 1935) probably applies to Pinanga, as the specimens cited with it belong there.

This species normally forms a conspicuous element in the forests of the high limestone islands and of the limestone portions of volcanic islands such as Korror and Babeldaob. Although not confined to the ridges it shows up especially against the sky along the high ridges of these rugged islands. While formerly abundant its continued existence is now seriously threatened. During the war most of the trees on islands close to Korror or where the Japanese maintained military posts were cut and the terminal buds used as cabbages for food by the soldiers. Then, after 1950, the remaining trees on all except some of the more isolated islands were attacked by the coconut rhinoceros beetle, Oryctes, to which they seem to be very susceptible. The adult beetle bores into the terminal bud. It is quite conceivable that the species will become extinct in the very near future unless the distance to certain of the more outlying islands proves too much for the beetle to cross. It is hoped that measures now being taken to control this coconut pest will be successful in time to save this elegant palm from complete disappearance.

CLINOSTIGMA, Wendl. in Bonplandia, x, 196 (1862); Burret, in Fedde Repert. xxiv, 292 (1928); Christophersen, in Bull. Bernice P. Bishop Mus. 128, 26-30 (1935).

Exorrhiza, Becc. in Ann. Jard. Bot. Buitenzorg, ii, 128 (1885); Burret, in Fedde Repert. xxiv, 294-295 (1928); Becc. in Webbia, xi, 130-134 (1955).

Bentinckiopsis, Becc. in Webbia, v, 113 (1921) [sphalm. Bentnickiopsis].

Clinostigmopsis, Becc. ex Martelli, in Atti Soc. Tosc. Sci. Nat. Pisa Mem. xliv, 161 (1934); Burret, in Notizbl. Bot. Gart. Berlin, xii, 591 (1935).

Tall single-trunked trees up to 20 m. tall, as much as 3 dm. thick near base, with 2-3 panicles below the well-developed crownshaft: leaves pinnate; sheath cylindric, closed; petiole concave above, convex below; pinnæ induplicate in vernation, regularly disposed, subopposite to alternate, those of mature leaves pendulous distally, linear-attenuate to a point, with midrib and 2 prominent lateral veins, these closer to margin than to midrib, marginal vein also developed but less prominent, all nerves puncticulate on lower side: inflorescences with 2 caducous bracts, outer inserted close to base of peduncle, oblanceolate, strongly compressed, wing-margined, splitting along inner face, the inner attached just above outer and conforming to it, but not margined, splitting along inner face; panicle glabrous, tending to be waxy, basal portion often prominently so, two to three times branched, ultimate rachillæ elongate, terminating in a fine usually flexuous point, panicle, at least when young, giving a broom-like effect, panicle branches subtended by tiny scale-like bractlets, flowers mostly in triads of 2 staminate and a central pistillate, triads arranged spirally on rachilla, flowers on distal portions of rachillæ mostly staminate and in pairs, bases of triads and pairs slightly immersed in rachilla which is expanded into a narrow lip, more expanded and flaring or even reflexed on lower side, here rounded to pointed; staminate flowers irregularly and obliquely pyramidal, more flattened on one side, pointed, sepals imbricate, but with central thickening forming a slight keel, petals slightly unequal, irregularly and obliquely ovate, valvate, stamens 6, filaments subulate, inflexed at apex in bud, and united at base, anthers basifixed, auriculate at base, not or scarcely prolonged beyond connective, pistillode ovoid or narrowly conic to columnar, slightly enlarged and trifid at apex, shorter than stamens; pistillate flowers ovoid, sepals imbricate, not enlarging but becoming indurate in fruit, petals imbricate but with apices slightly produced and more or less valvate not much enlarging but becoming indurate in fruit, forming a cupule, staminodia 3-6, ovary apparently ovoid, cell in basal third, stylar portion thick, crowned by shortly trilobed stigma, ovule 1, attached laterally: fruit globose to oblong and somewhat compressed, tubercle formed by style and stigma eccentric to lateral, exocarp smooth when fresh, slightly to moderately longitudinally ribbed when dry, mesocarp fleshy with fibers of several orders, a very heavy one running from stylar tubercle to base, moderately heavy ones longitudinal and arching

over to the stylar remains, fine ones between these, endocarp thin, papery, free from seed; seed globose to oblong and slightly compressed, attached by small circular to elongate lateral or sub-basal hilum, covered by a loose ascending network of vascular strands, endosperm hard, homogeneous, embryo basal.

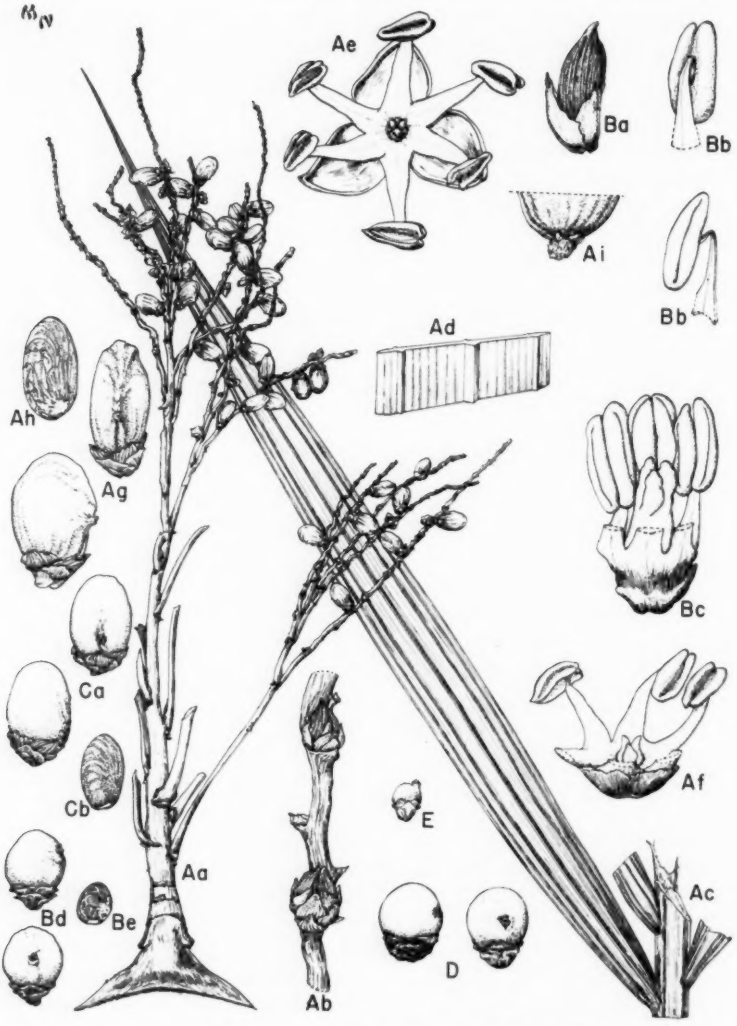
Definition of genera in the taxon delimited by Beccari as tribe Clinostigmeæ of subfamily Arecoideae (Webbia, xi, 13, 22, 1955) is difficult. Morphological and geographical affinities are close. The genera occur so far as is known only in Lord Howe Island, the Fiji Islands, New Hebrides, New Caledonia, Carolines, Samoa, Bonins and possibly the Nicobar Islands and Travancore if Bentinckia is included in the tribe. Differences in size and shape of fruit have been used to create numerous small genera in a group that has in common many distinctive characters. The Micronesian genus Bentinckiopsis of this alliance and the closely related or identical genera Exorrhiza, Clinostigmopsis and Clinostigma have been variously interpreted (*).

It is not yet possible to complete a satisfactory study of all the genera of Clinostigmeæ but the genus Bentinckiopsis, confined to the Caroline and Bonin Islands, requires attention in this paper. Burret has in turn united it with Exorrhiza (1928) and regarded it as distinct (1935). In the last paper he based his separation on the character of the hilum: elongate, traversing the entire length of the seed in Exorrhiza; short, round, basal in Bentinckiopsis. He noted that without mature fruit it had not been possible to distinguish the genera previously.

Such a distinction would seem to obscure more obvious relationship based on vegetative, inflorescence and floral characters. Position of the stigmatic remains varies from obliquely subapical to nearly basal in the tribe Clinostigmeæ, depending on the growth differential between the outer side of the pistil and the inner side where the development of strong fibers, perhaps representing abortive carpels, appears to exercise a restraining influence. The external reflection is seen in the three fruits illustrated in Fig. 136 where stigmatic remains are nearly median (Ag), below the middle (Ca) or above the middle (Bd). Relationship between attachment of the seed and differential growth is not clear from the material at hand. An elongate hilum appears to be associated with the more nearly apical stigmatic position (as in *Clinostigma onchorhyncha* or *C. savaiiense*) while in *Clinostigma samoënse*, type species of the genus, the stigmatic remains are nearly median.

Opposed to the single differentiating factor of hilum-length are great

* Becc. in Webbia, v, 113 (1921).
Becc. ex Martelli, in Atti Soc. Tosc. Sci. Nat. Pisa Mem. xliv, 161-171 (1934).
Becc. in Webbia, xi, 118, 113, 137 (1955).
Burret, in Fedde Repert. xxiv, 294-296 (1928).
Burret, in Notizbl. Bot. Gart. Berlin, xii, 591-593 (1935).



136. CLINOSTIGMA. A, CLINOSTIGMA PONAPENSIS. Aa, spadix ×2/9; Ab, portion of rachilla ×2; Ac, pinnæ ×1/4; Ad, cross-section of leaf (diagrammatic) to show position of veins; Ae, staminate flower ×5; Af, staminate flower with pistillode in lateral view ×6; Ag, fruit, lateral and front view ×1; Ah, seed ×1; Ai, staminodes ×2. B, CLINOSTIGMA SAVORYANA. Ba, staminate flower in bud ×5; Bb, stamen in bud, back and side views ×10; Bc, stamens and pistillode ×10; Bd, fruit, side and front views ×1; Be, seed ×1. C, CLINOSTIGMA CAROLINENSIS. Ca, fruit, side and front views ×1; Cb, seed ×1. D, CLINOSTIGMA SAMOENSE, fruit in side and front views ×1. E, CLINOSTIGMA EXORRHIZA, immature fruit ×1.

similarities between species referred to Bentinckiopsis and those referred to Exorrhiza, Clinostigmopsis and Clinostigma. The tall habit, the waxy epidermis of upper trunk and spadix, the cutting, nervature and peculiar vestiture of leaves, the similar spadices, the pistillode and other parts of the staminate flowers agree in detail with those of available representatives of the allied genera. The oldest generic named applicable to all these genera is Clinostigma.

Material studied by Wendland and described as *Clinostigma samoënse* was collected by Pickering (according to Wendland) on Upolu Island, Samoa during the United States South Pacific Exploring Expedition of 1833-42. It is evident from Wendland's comments that the material was mixed with fragments from Savaii but the major part of the description corresponds with what appears to be a duplicate specimen at the Gray Herbarium. The specimen consists of a portion of a leaf labelled as from Opalau, Samoan Islands, annotated with an unpublished name in Wendland's handwriting, later changed to *Clinostigma samoënse* in another hand, and some loose immature and nearly mature fruits labelled Opalau, Friendly Islands. Fruit from the latter is illustrated as Fig. 136D. The accompanying section of a leaf is similar to corresponding portions of specimens of Bentinckiopsis and Exorrhiza from the Carolines and Fiji.

Christophersen (1935) has summarized much of our information about Clinostigma in Samoa but has not been able to amplify our knowledge of *C. samoënse*. The specific problem remains but on the generic level there seems to be no reason to maintain Bentinckiopsis as a separate genus.

Exorrhiza also falls within the limits of Clinostigma but some explanation is required to clarify Beccari's notes on the genus as they appeared recently in Webbia (xi, 130-134, 1955). The basis for Exorrhiza is Wendland's description of *Kentia exorrhiza* in Bonplandia (x, 191, 1862), excluding the fruit. Burret has discussed the genus and designated as type *Seemann no. 660* (1928). Although the fruit described by Wendland was admittedly that of *Veitchia Joannis* (Wendland in Seemann, Fl. Vitiensis, 270, 271, 1868), and extraneous material collected by Fickering at Rewa was mentioned, the description in Bonplandia accords well with Seemann's specimen and with the description and plate appearing in Flora Vitiensis, Beccari's comments notwithstanding. A recent collection (*A. C. Smith 8364*, BH, US) from the vicinity of the type locality agrees with both descriptions and with the details of the plate. Immature fruit from Smith's collection is figured as 136E.

Beccari has attributed leaves with præmorse apices similar to those of Drymophlœus to the genus (1955). From what material he drew this conclusion we do not know nor has Pichi-Sermolli found any clarifying evidence. It is distinctly at variance with our knowledge of Exorrhiza. Burret has reduced Clinostigmopsis to Exorrhiza (1935). The latter genus in its

original sense cannot be adequately separated from Clinostigma and must, therefore, be replaced by the older name.

Distribution of Clinostigma as understood at present is limited to the Fiji Islands with 3 species (*), New Hebrides with 1 species, Samoa with 5 or 6 species, Carolines with 2 species and the Bonin Islands with 1 species. The three species in Micronesia are distinguished as follows:

1. Fruit about 6 mm. high: flowers borne in triads in the lower two-thirds to four-fifths of the rachillæ, paired ♂ above..... *C. Savoryana*
1. Fruit 15-22 mm. high: flowers borne in triads in lower one-third to one-half of the rachillæ, paired ♂ above.
   2. Fruit strongly compressed and ridged laterally, 18-22 mm. high.... *C. ponapensis*
   2. Fruit not or only slightly compressed and ridged laterally, 15 mm. high.. ..... *C. carolinensis*

† **Clinostigma carolinensis,** (Becc.) comb. nov. Fig. 136C.

Cyphokentia? carolinensis, Becc. in Engler Bot. Jahrb. lii, 4 (1914).

Bentinckiopsis carolinensis, (Becc.) Becc. in Webbia, v, 113 (1921), in Engler Bot. Jahrb. lix, 16 (1924), in Nuov. Giorn. Bot. Ital. n.s. xlii, 32 (1934), and ex Martelli, in Atti. Soc. Tosc. Nat. Pisa Mem. xliv, 165 (1934); Martelli, in Nuov. Giorn. Bot. Ital. n.s. xli, 714 (1934); Burret, in Notizbl. Bot. Gart. Berlin, xii, 593 (1935), xv, 88 (1940); Krämer in Thilenius, Ergebnisse der Südsee Expedition 1908-1910, IIb, 5, Truk 419 (1932); Kanehira, in Bot. Mag. Tokyo, xiv, 274 (1931) partim, Fl. Micr. 73 (1933); Kanehira & Hatusima, in Bot. Mag. Tokyo, liii, 189 (1939).

Exorrhiza carolinensis, (Becc.) Burret, in Fedde Repert. xxiv, 296 (1928); Kanehira, in Journ. Dept. Agr. Kyushu Univ. iv, 284 (1933), in Bot. Mag. Tokyo, xlv, 274 (1931), xlviii, 731-2 (1934), in Journ. Jap. Bot. xii, 635 (1936); Hosokawa, in Bull. Biogeogr. Soc. Japan, vii, 184 (1937).

Scyphokentia Krämeri, Volkens ex Krämer in Thilenius, Ergebnisse der Südsee Expedition 1908-1910, IIb, 5, Truk 419 (1932) in syn.

Tree 12-15 m. tall, trunk to 25 cm. thick near top: leaves large, rather straight, 3-5 m. long, pinnæ numerous, equidistant, alternate, up to 86 (-100) cm. long, to 3.5 cm. wide, linear, with a long-attenuate entire apex which splits and becomes bifid when frayed, attached to rachis by a rather oblique V-shaped base, the distal half somewhat decurrent on the rachis, rigidly chartaceous: inflorescence up to 75 cm. long; peduncle short, 55 mm. wide, 25 mm. long, groups of flowers numerous, 1-2 mm. apart on rachilla, subtended by acute processes, the apices of which tend to be reflexed especially distally on the rachilla, sterile tips of rachillæ filiform,

* The following transfer is required.
† **Clinostigma Smithii,** (Burret) comb. nov.
Exorrhiza Smithii, Burret, in Bernice P. Bishop Mus. Occ. Papers, 11 (4), 3 (1935).

flexuous, flowers in triads in lower half or third, paired staminate ones above: staminate flowers 3-3.5 mm. long, ovoid, asymmetric, bluntly acute, sepals 1.5 mm. high, petals 2.7-3 mm. high, 1.2-1.5 mm. wide; pistillate flowers ovoid, sepals 2.5-3 mm. high, outer 5 mm. wide flattened out, about the same in fruit but indurate, petals 3 mm. high, 3-5 mm. in fruit, pistil 2.5 mm. high: fruit broadly oblong, rounded at ends, 15 mm. long, 11 mm. wide, 9 mm. thick, smooth, obscurely granulose when dry, base enclosed in perianth-cup, stylar tubercle and stigma lateral, borne below middle, 5-7 mm. above base, tending to point upward, exocarp separable from mesocarp, mesocarp about 1 mm. thick, thicker on side bearing stylar tubercle, endocarp very thin, hard, brittle, shiny within; seed oblong, rounded at ends, 11-12 mm. long, 6-7 mm. wide, terete, attachment just below stylar tubercle in fruit, just above base of seed, vascular strands in seed-coat 8-10 on a side, arching upward and backward from very short raphe, descending on back of seed and very slightly anastomosing and entering a darker disk surrounding micropyle which is basal.

Caroline Islands. Truk: Fefan, upper altitudes on Mt. Ibal, *T. Hosokawa 3371* (FU, A, TI); Tol, at upper altitudes, *Hosokawa 8284* (FU); Natu-sima August 1933, *Truk District Office* (*Kanehira's*) *3724* (FU, TI); Moen, ridge east of Moen Village, 110 m., November 22, 1949, *D. Anderson 794* (seedlings only) (BH, BISH, US). [Type *Kraemer* in 1910, from Truk, not seen, *Ledermann* in 1914, on which much of Beccari's description was based not seen]. Native name "Kiniau," "Gilian," or "Tiniau" (acc. Kraemer), "Kiriyau" acc. Kanehira.

Endemic to Truk, found in the few remnants of primary forest on Truk, and persisting even on open slopes and ridges at rather low altitudes, always on volcanic soil. Available material of this species is very inadequate, consisting only of several detached panicle-branches with flowers and fruit, a segment of a leaf, and some very young seedlings.

† **Clinostigma ponapensis,** (Becc.) comb. nov. Fig. 136A.

Bentinckiopsis ponapensis, Becc. in Webbia, v, 113 (1921), in Nuov. Giorn. Bot. Ital. n.s. xlii, 32 (1934), ex Martelli, in Atti Soc. Tosc. Sci. Nat. Pisa Mem. xliv, 165-167 (1934); Martelli, in Nuov. Giorn. Bot. Ital. n.s. xli, 714 (1934); Kanehira, in Bot. Mag. Tokyo, xlv, 274 (1931) partim, Fl. Micr. 72, pl. 12, fg. 1 (1933); Kanehira & Hatusima, in Bot. Mag. Tokyo, liii, 189 (1939); Burret, in Notizbl. Bot. Gart. Berlin, xii, 594 (1935), xv, 88 (1940); Hosokawa, in Trans. Nat. Hist. Soc. Taiwan, xxxiii, 118 (1943).

Exorrhiza ponapensis, (Becc.) Burret, in Fedde Repert. xxiv, 296 (1928); Kanehira, in Bot. Mag. Tokyo, xlviii, 732 (1934), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 284 (1935), in Journ.

Jap. Bot. xii, 635 (1936); Hosokawa, in Kudoa, iii, 162-166 (1935); Glassman, in Bull. Bernice P. Bishop Mus. 209, 110 (1952).

Tree up to 20 m. tall, 3 dm. thick near base, covered by a white wax-impregnated very finely cellular pellicle or epidermis tending to separate when dry with scattered elliptical stomata, leaf-scars 1-23 mm. apart irregularly spaced, seemingly in groups of closely spaced ones separated by a wider space: leaves 3-5 m. long, somewhat arching, pinnæ slightly arching and spreading, equidistant, about 5 cm. apart, subopposite to alternate, linear, apex long-attenuate, splitting in two when frayed, up to 80 cm. long, 4.5 cm. wide, apical 51 cm. long, 2.8 cm. wide; petiole short, about 15 cm. long; sheath 120 cm. high, deeply concave above, strongly and closely ribbed when dry, sinus 10 cm. deep, roughly V-shaped: inflorescence large, twice branched, up to 70 cm. long in fruit, peduncle whitish, rachillæ up to 40 (or 50 acc. Beccari) cm. long, slender, up to 4 mm. thick, thickening somewhat in fruit to 6 mm., tips in flowering state almost filiform, flexuous, flowers in triads in lower half, paired staminate ones above: staminate flowers in bud ovoid-trigonous, acutish, sepals 1.5 mm. long, irregular, slightly gibbous, and obliquely carinate well above base, portion included in rachilla plane, petals ovate, acutish, longitudinally striate, 3 mm. long, 1.5-2 mm. wide, stamen-filaments when dry 2.5 mm. long, anthers when dry 1-1.5 mm. long, pistillode ovoid barely 0.6-0.8 mm. long, conspicuously trifid at apex; pistillate flowers globose-ovoid, 4-5 mm. long, sepals and petals strongly imbricate, outer sepal somewhat gibbous, sepals and petals rather similar, indurate but not enlarging much in fruit, forming a cup enclosing base of fruit, staminodia 6, pistil ovoid: fruit broadly oblong, compressed, 18-22 mm. long, 13-15 mm. in greatest width, 9-10 mm. thick, rounded at base and apex, externally rugulose when dry, longitudinally ribbed, bicarinate ventrally below stylar tubercle, which is at or near middle of ventral side, strongly and obtusely carinate above this, mesocarp with a layer of spherical sclerosomes, heavy fibers prominently thickened and slightly anastomosing near top; seed oblong, 13 mm. long, 8 mm. wide, 7.5 mm. thick, attachment small, subbasal.

Caroline Islands. Ponape: Tolun Nanket, mountain above Nanipil, drainage of Tawenjokola River, Not Distr., 500 m., August 13, 1946, *Fosberg 26444* (BH, BISH, US); Mt. Ninioanii, August 12, 1933, *Hosokawa 5621* (A); Nipit-One, August 16, 1933, *Hosokawa 5828* (A); Mt. Nanaraut, July 15, 1936, *Hosokawa 8225* (A, US); s.l., 100-200 m., July and August 1931, *Kanehira 1675* (US, FU); Sankakuyama, above 500 ft., August 1929, *Kanehira 770* (FU, 2 sheets, TI).

This species was based on *Ledermann 13201* and *13623*, which are unavailable, probably destroyed at Berlin, and secondarily also on a specimen collected by Schnee in 1909, likewise unavailable.

This palm is endemic to Ponape and is a dominant plant in wet forests at from 120 to 700 m. altitude. Its seedlings, with bifid leaves, thrive very well in the shade and it reproduces itself when cut out. It grows naturally only on volcanic soil.

The Ponapean name is "Kotop" according to Glassman. During the war the Japanese made extensive use of the cabbages of this palm for food, felling considerable acreages above Nanipil.

The plant differs from both *C. carolinensis* and *C. Savoryana* in its much larger strongly compressed fruits.

† **Clinostigma Savoryana,** (Rehd. & Wils.) comb. nov. Fig. 136B.

Cyphokentia Savoryana, Rehd. & Wils. in Journ. Arnold Arb. i, 115, t. II, fig. 1 (1919).

Bentinckiopsis Savoryana, (Rehd. & Wils.) Becc. in Webbia, v, 113 (1921) (sphalm *Bentnickiopsis*), in Atti Soc. Tosc. Sci. Nat. Pisa Mem. xliv, 171-172 (1934), in Nuov. Giorn. Bot. Ital. n.s. xlii, 32 (1935); Martelli, in Nuov. Giorn. Bot. Ital. n.s. xli, 712 (1934); Burret, in Notizbl. Bot. Gart. Berlin, xii, 593 (1935).

Exorrhiza Savoryana, (Rehd. & Wils.) Burret, in Fedde Repert. xxiv, 296 (1928).

Cyphokentia boninensis, Warb. ex Burret, in Fedde Repert. xxiv, 296 (1928), in syn.

Tree up to 16 m. tall, trunk annulate, smooth, about 15 cm. diameter: leaves about 12, 1-3 m. long, erect to spreading and slightly arching, with 50-60 pendulous pinnæ on each side, sheath up to at least 70 cm. long, lepidote with reddish caducous scales, petiole concave above, convex below, 45-60 cm. long, lepidote, pinnæ linear-lanceolate, 35-55 cm. long, 2.5-3 cm. wide, 1-3 cm. apart: inflorescence with outer bract attached 2.8 cm. or more above base, 33.5 (to 70) cm. long, 6 (to 20) cm. wide, with prominent light brown scales closely disposed along the edge of the marginal wing, inner bract attached 5 mm. or more above attachment of outer, whole panicle at least 35-45 cm. long in flower elongating to as much as 45-100 cm., rachillæ about 30-33 cm. long, elongating in fruit, flowers disposed in triads in the lower two-thirds to four-fifths of the rachilla, pairs of staminate distally, tips attenuate or filiform, very flexuous, triads and pairs irregularly spirally arranged, 2-5 mm. apart: staminate flowers unequal in length, ovoid, quite asymmetric, sharply pointed, 4-4.5 mm. long, sepals triangular-ovate, unequal, obtusish to bluntly acute, carinate, 2-2.6 mm. long, petals valvate, ovate to narrowly oblong-ovate, acutish, 3.2-4 (or 5) mm. long, 1.2-1.6 mm. wide, striate when dry, lineate when boiled up, filaments 1.2-1.4 mm. long, anthers oblong 1.2-1.4 (-2) mm. long, pistillode 1.2 mm. high, ovoid-conic; pistillate flowers ovoid, about 4 mm. long, sepals 2.8-3 mm. long, orbicular-ovate, obtusely apiculate, petals orbicular-ovate, obtusely apiculate, 3-3.4 (-4) mm. long, pistil 3 mm. long: fruit elongate-globose, scarcely compressed, black and with a slight bloom (when fresh?), 12 mm. long, 9.5 mm. wide, 8 mm. thick, rounded at apex, somewhat pointed at base, externally rugulose and dorsally slightly ribbed when dry, stylar tubercle well above middle, a low ridge both below and above it, fibers in mesocarp flexuous and branched above, principal ones straight below; seed globose-ovoid, very slightly

compressed, 6 mm. high, 5.2-5.5 mm. wide, 4.8-5 mm. thick, vascular strands in seed-coat only very slightly anastomosing.

Bonin Islands: s.l., *C. Wright* in 1853-56 (US). Mukojima, April 28, 1917, *Wilson 8334* (A, type, US, isotype, BH photo and fragment); Yasi-zawa, December 5, 1935, *Tuyama* (TI). Anijima, August 7, 1930, *Yamamoto* (TI). Otojima, August 5, 1930, *Yamamoto* (TI); Ototojima, July 6, 1920, *Nakai* (TI). Chichi-jima (Titizima), 1936 and 1937, *M. Okabe* (TI); April 4, *Tuyama* (TI, 2 sheets); June 30, 1920, *Nakai* (TI); cult. at Kiyose, March 2, 1937, *Tuyama* (TI, 2 sheets); Tahedabokujo, June 25, 1932, *Tuyama* (TI, 4 sheets); *Wilson 8212* (A). "Mukoojima, Hahajima," June 29, 1932, [*Tuyama*] (TI). Hahajima, July 16, 1920 *Nakai* (TI, 2 sheets).

Endemic to the Bonin Islands, said by Rehder and Wilson to be found on all the larger islands; during the war it was all but exterminated on Chichi-jima by Japanese soldiers who used it for cabbages. In 1946 only a single very young tree was seen. The local inhabitants said no large ones were on the island but they might still be seen in Anijima. Wilson indicates on his labels "a very superior Cabbage Palm." It is mentioned by Kaempfer (Hist. Jap. i, 60, 1729) as "the Arrack tree," by Beechey (Voy. Pac. Ber. Str. 515, 1831) as *Areca oleracea*, by Kittlitz (Twenty-four views Veg. Pac. 48, 1861), as "the slender growing Areca," and by Hattori (Journ. Coll. Sci. Imp. Univ. Tokyo, xxiii (10), 22, 44, pl. II, 1908) as "*Ptychosperma elegans* Bl." The captions of plates II and IV are reversed in Hattori's work. Plate II is an excellent view of this palm growing in its native habitat.

PTYCHOSPERMA, Labill. in Mem. Classe Sci. Math. Phys. Inst. France, Paris, ix, 252 (1809).

Ponapea, Becc. in Engler Bot. Jahrb. lix, 13-14 (1924), in Atti Soc. Tosc. Sci. Nat. Pisa Mem. xliv, 148-149 (1934); Kanehira, in Journ. Jap. Bot. xii, 729 (1936).

Slender, single-stemmed or cæspitose, unarmed, monœcious palms with pinnate leaves, the pinnæ reduplicate in vernation with prominent central and marginal nerves, apices obliquely truncate and conspicuously erose, sheaths closed, lepidote: inflorescence a two to four times branched panicle borne below the leaves, in bud enclosed in 2 caducous spathe-like bracts, the outer flattened, strongly wing-margined, pointed, tending to split down both sides, splitting and falling away, leaving a scar almost at base of peduncle; inner longer than outer, compressed clavate, strongly and abruptly acuminate into a flat linear beak, splitting along inner face, falling, leaving a scar a short distance above the scar of the outer bract; panicle alternately loosely ramified, nodes somewhat thickened, bearing flowers in triads of 1 pistillate and 2 staminate, the distal few on a rachilla often reduced to pairs of staminate, pistillate maturing later than staminate,

ramifications subtended by small to minute scale-like bractlets, these becoming practically invisible distally, individual flowers subtended by 1 or 2 minute scale-like bractlets which persist somewhat as a shallow cup: staminate flowers oblong-ovate, sepals strongly imbricate, rounded, thickened centrally and slightly gibbous at base, petals very firm, strongly concave, elliptic- to oblong-ovate, twice or more longer than sepals, smooth and opaque to very lightly ridged and striate when dry, conspicuously valvate, stamens numerous, inner almost as long as petals, outer shorter, filaments filiform, subulate, anthers erect, basifixed, linear-lanceolate, strongly and often unequally auriculate at base, bifid at apex, cells produced beyond connective, becoming strongly twisted at maturity and when dry, pistillode lageniform with enlarged base and elongate neck or ovoid-conic slightly produced and very slightly trifid or tripapillate at apex, with conspicuous stylar tube and minute cell at base in longitudinal section; pistillate flowers with sepals similar to staminate, outer one more strongly gibbous, enlarging and persistent in fruit, petals strongly imbricate, umbonate and almost valvate at tips, enlarging and persistent in fruit, staminodia 3-6, strap-shape to subulate, blunt to acute in flower, ovate in fruit, pistil ovoid, basal half (or ovary) soft, shrinking in drying, upper or stylar part firm, with conspicuous stylar tube, crowned by 3-lobed stigma, lobes grooved, somewhat recurved, cell in lower half of pistil (or ovary), ovule attached near top of cell: fruit ovoid to ellipsoid, small to moderate, symmetric or very slightly asymmetric, pointed at apex, subtended by firm enlarged persistent perianth-cup, exocarp smooth, mesocarp rather thin, firm, with abundant strong longitudinal fibers massed especially in the parts opposite the grooves in the seed, endocarp thin, hard, horny, glossy inside, often free from seed except for linear lateral attachment; seed longitudinally shallowly 3-5-sulcate, seed-coat thin, parchment-like, freed with difficulty from endosperm, with strong ramified and anastomosing vasculation, endosperm hard, homogeneous or ruminate with a tiny cavity in center, embryo basal.

Ponapea, a genus restricted to Micronesia, has been distinguished from the closely related genus Ptychosperma chiefly on the basis of its large, ovate briefly trifid rather than lageniform pistillode, of its supposedly larger flowers, fruit of larger proportions and the fragile endocarp. Examination of a series of specimens and descriptions leads to the conclusion that these differences are not of sufficient measure to warrant separate genera. Staminate flowers of Ponapea are not significantly larger than those of *Ptychosperma Macarthuri*, for example, and in flowering material of *P. palauensis* (*Gressitt 44*) the pistillode is attenuate from a thickened base as in Ptychosperma proper. The elongate fruit of *P. Ledermanniana* and *P. Hosinoi* is similar to that of *P. Hartmannii*, Becc. in proportion if not in size while fruit of *P. palauensis* is similar in shape to the smaller fruit of many species assigned without question to Ptychosperma. Endocarp varies but is never osseous as in Ptychococcus.

The three species hitherto set apart in Ponapea are similar to the typical species of Ptychosperma in having solitary trunks, and similar to those species formerly known as Actinophlœus (but now included as a

subgenus in Ptychosperma) in having homogeneous endosperm. They differ from both types in having larger fruit (2.2-4.4 cm. long) and at least in *P. Hosinoi* and *P. Ledermanniana* in having an ovate apically trifid pistillode. The three Micronesian species have been illustrated in Kanehira in Journal of Japanese Botany, xii, and may be distinguished as follows:

1. Stamens 110-112: fruit fusiform, 3.6-4.4 cm. long: panicle glabrous. *P. Ledermanniana*
1. Stamens 50-60: fruit ovoid, 2.2-3.2 cm. long: panicle sparsely to densely dark-brown lepidote at least on peduncle and lower branches.
   2. Rachillæ strongly flexuous: fruit 3.2 cm. long: pinnæ oblanceolate, the median to 16 (-23) cm. wide. ..... *P. Hosinoi*
   2. Rachillæ only slightly flexuous: fruit 2.2 cm. long: pinnæ oblong-lanceolate, the median 5.5-7 cm. wide. ..... *P. palauensis*

† **Ptychosperma Hosinoi,** (Kanehira) comb. nov.

Ponapea Hosinoi, Kanehira, in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 432 (1935) and in Journ. Jap. Bot. xii, 731 (1936); Burret, in Notizbl. Bot. Gart. Berlin, xv, 91 (1940); Glassman, in Bull. Bernice P. Bishop Mus. 209, 111 (1952).

The name *Ponapea Hosinoi* was validly published in 1935, though the description was very scanty.

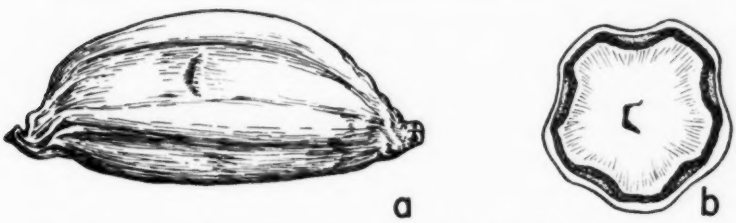
Tree up to 15 or more m. tall, trunk to 20 cm. thick: leaves 3 m. long, rachis lepidote with brown peltate lepidiæ and larger still but minute dark brown pointed scales; pinnæ more or less equidistant up to 7-9 cm. apart, apical 18 cm. long, 3 cm. wide, oblanceolate, irregularly truncate, median lanceolate, to 80 [110 acc. Kanehira] cm. long, to 16 [23 acc. Kanehira] cm. wide, apex very obliquely and irregularly truncate, median nerves very prominent, 4 secondary nerves including marginal ones, the latter with a sharp thin keel forming actual margin, minor nerves of at least 5 orders irregularly developed and spaced, dark brown scales on both surfaces near base, those on upper surface very numerous and extremely variable in shape and size, up to 2 mm. long, mostly on nerves, especially midnerve, diminishing distally in size and number, those on lower surface less numerous, irregularly linear-lanceolate, attached at the often narrowed base, up to 15 [rarely 20] mm. long: inflorescence 60 cm. or usually more long, bracts missing from available material, scars 2.5 cm. and 6.5 cm. above base on only specimen available, panicle diffusely branched three times, main axis with at least 15, usually probably more branches, densely covered with minute narrow dark brown scales, appearing dark brown tomentose, peduncle 9 mm. wide (or more) somewhat compressed, ultimate rachillæ very conspicuously flexuous or zigzag, node to node, tapering to about 1 mm., internodes 2 to 10 mm. long, mostly 4-5 mm., flowers in triads and with pairs of staminate on distal half or more of rachilla, this part tending to break off in fruit: staminate flowers 7 mm. long, with sepals 1.5-2 mm. long, petals 6 mm. long, 3.5-4 mm. wide; stamens about 50, filaments varying in length to 3 mm., anthers 2-2.5 mm. long, narrowly oblong, not strongly curved at dehiscence, pistillode subglobose, 1 mm. high, pistillate flowers only 3.5 mm. long when staminate are in anthesis, at or just after anthesis 7 mm. long, sepals 4 mm. long, petals 5 mm. long,

ovoid conical style exserted about 3 mm.: fruit red when ripe, ovoid, slightly oblique 3.2 cm. long, 1.7-1.9 cm. broad, fruiting calyx 2.5-3 mm. fruiting corolla 5 mm. long, indurate, forming a shallow cupule.

Caroline Islands. Ponape: s.l. January 1915 *G. Koidzumi* (TI, 3 sheets); s.l. January 20, 1937, *R. Kanehira 3934* (FU); Mt. Tolenkuip, 400 ft., July 14, 1949, *S. F. Glassman 2529* (US, 2 sheets); Kamal, Nat, 50 m., September 1935, *Hosino* (*Kanehira's*) *3703* (FU, type, 2 sheets); Parkiel, Kolonia, 500-1000 ft., August 1925, *Kanehira 742* (FU); Mt. Sankaku, Kolonia, 100 m., July 15, 1939, *S. Hatusima 10,788* (FU); Nampil, August 25, 1933, *T. Hosokawa 6034* (A, 2 sheets, US); Coloma-Palkier kan Nanpomaru, August 23, 1940, *T. Hosokawa 9543* (A, 2 sheets). [Toleailuka, 7 March 1936, *Takamatsu 835*, fide Burret.]

Endemic to Ponape, growing in rain forests at low to moderate altitudes up to 350 m., on volcanic soils.

† **Ptychosperma Ledermanniana,** (Becc.) comb. nov. Fig. 137.



137. Ptychosperma Ledermanniana. a, fruit ×1; b, fruit in cross-section ×1.

Ponapea Ledermanniana, Becc. in Engler Bot. Jahrb. lix, 14 (1924); Kanehira, in Bot. Mag. Tokyo, xlv, 274 (1931), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 284 (1935), in Journ. Jap. Bot. xii, 731 (1936); Glassman, in Bull. Bernice P. Bishop Mus. 209, 111 (1952).

Ponapea kusaiensis, Burret, in Notizbl. Bot. Gart. Berlin, xv, 92 (1940).

Slender tree, up to 10-12 m. tall, trunk about 10 cm. in diameter, outer woody cylinder hard: leaves 2-3 m. long; sheath grayish lepidote becoming brownish, strongly striate when dry, about 50 cm. long, sinus V-shaped, thin-margined; rachis closely light-brown lepidote when young, puncticulate when older; pinnæ more or less equidistant, opposite to subopposite, up to at least 9 cm. apart, obliquely truncate, median at least 68 cm. long, 5.8 cm. wide, apical ones to 45 cm. long, 3.9 cm. wide, strongly oblique, petiole 27 cm. long, concave above, pinnæ 4 cm. lower on one side than other, median and marginal nerves prominent, 2 secondaries on

either side, elevated and sharp on upper surface, rounded below, minor nerves of at least 3 orders irregularly developed in intervals, conspicuous dark brown narrow tightly twisted basifixed scales 3-7 mm. long scattered on median and secondary nerves on lower surface near base, marginal nerves brown punctiulate: panicle diffuse, glabrous, about 60-80 cm. long; bracts inserted about 1-2 cm. above base and about 1-2 cm. apart, outer bract up to 30 cm. long, lanceolate, inner about 40 cm. long, about 5.5 cm. wide at widest part, acumen about 4 cm. long, 7 mm. wide; peduncle 1.8-2.5 cm. wide, somewhat compressed, rounded at edges, primary branches 7-12 mm. at widest part, ultimate rachillæ 1.5-2 mm. thick, slightly flexuous toward tips, internodes 1.5-2 cm. long ultimate ones shorter: flowers white, staminate about 1 cm. long 0.5 mm. wide in mature bud, apex obtuse, calyx 3 mm. long, petals 9 mm. long, 3.5-4.5 mm. wide, stamens between 110 and 120, filaments 2-3.5 mm. long, anthers 3-3.5 mm. long, shrinking and curving on dehiscence, pistillode 3 mm. long; pistillate flowers in bud 6 mm. high, sepals 3 mm.: fruit red when ripe, fusiform, 3.6-4.4 cm. long including basal cupule, 1.6-1.7 cm. thick at widest part, crowned by the ovoid indurate style, 2-3 mm. high.

Caroline Islands. Ponape: slopes above Nanipil toward Tolun Nanket mountain, drainage of Towenjokola River, Not Distr. 250 m., August 13, 1946, *Fosberg 26466* (US, BH, BISH); Mt. Tolenkiup, 400 ft., July 14, 1949, *Glassman 2528* (US, 2 sheets); Nut, January 18, 1937, *Kanehira 3924* (FU); s.l. January 1915, *Koidzumi* (TI, 3 sheets). Kusaie: north ridge of Mt. Matanta (Buache), above Tafonshak Village, August 20, 1946, *Fosberg 26608* (BH, BISH, US); near Maarem 300 m., August 10, 1939, *Hatusima 11, 162* (FU); s.l. 500 m., July 1931, *Kanehira 1361* (FU, 2 sheets, US, 2 sheets); Finkol, July 19, 1938, *Hosokawa 9342* (A, US); Hinkolu, March 16, 1937, *Kanehira 4180* (FU). [The type, *Ledermann 13397* was not seen, nor was that of *P. kusaiensis*, *Takamatsu 341*.]

Burret's distinction between *P. Ledermanniana* and *P. kusaiensis* based on thickness of rachillæ and shape of bracts subtending branches of the panicle is not valid when a series of specimens is examined.

A rain forest tree, mostly in second story, commonest at relatively low elevations, at least in Ponape, but reaching 600 m. in Kusaie near top of Mt. Matanta, where the crown is emergent from the low scrub-forest. Found only on volcanic soils.

Native name "Kattai" on Ponape according to Glassman and Kanehira, "Kuter" according to Kanehira. The young bud is said by Glassman to be not tender enough for eating.

† **Ptychosperma palauensis,** (Kanehira) comb. nov.

Ponapea palauensis, Kanehira, in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 432 (1935), *nomen nudum*, and in Journ. Jap. Bot. xii, 732 (1936).

Tree with leaves about 2 m. long, rachis slender, very sparsely and minutely lepidote with dark brown scales, pinnæ tending to be in pairs but not quite opposite, pairs up to 10 cm. apart, apical about 17 cm. long, 3 cm. wide, oblong-oblanceolate, irregularly truncate, slightly oblique, median 44-62 [or 70] cm. long, 5.5-7 cm. wide with sparse minute brown lepidiæ on upper surface near base, midnerve and marginal nerves prominent, 1 secondary nerve on each side, 3-4 orders of minor veins, the finest numerous and not quite regularly spaced, these bearing numerous minute brown round peltate lepidiæ: inflorescence twice branched, loose, bracts unavailable, scar of first bract 13 or more mm. from base, second 53 or more mm., peduncle and larger branches sparsely dark brown lepidote, rachillæ tapering from 2.5 to 1 mm. thick, somewhat flexuous internodes 12-6 mm. long, shortened distally, bearing flowers in triads to within last three to six nodes, distal ones with pairs of staminate flowers: staminate flowers 8-9 mm. long, sepals 2.5 mm. long, petals 7-7.5 mm. long, 3 mm. wide, oblong, stamens about 60, filaments variable 2-2.5 mm., anthers linear 3-3.5 mm. long, curving somewhat distally when dry, pistillode long-attenuate, subulate, from a thickened base, 5 mm. long, apex very fine; pistillate flowers broadly ovoid in bud, 4 mm. wide, 3 mm. high, sepals and petals 3 mm. high, but quite immature, pistil narrowly ovoid but very immature: fruit not quite mature, ovoid, 22-23 mm. long, 11-17 mm. wide, capped by indurate ovoid-conic style 1.5 mm. high, 2-2.5 mm. wide, calyx in fruit 3.5 mm. long, corolla 6-8 mm. high, indurate, forming a shallow cupule.

Caroline Islands: Palau Group; Korror Island, Arumizu, September 1933, *S. Nisida 3273* (FU, type); Auluptagel Island, December 1952, *Gressitt 44* (BH, US).

This species is endemic to Palau, and almost nothing is known about it. It apparently inhabits limestone, which is exceptional for section Ponapea.

The elongate pistillode of this species serves to break down the distinction between Ponapea and Ptychosperma and the fruit size is intermediate also.

COCOS, L. Sp. Pl. Ed. 1, 1188 (1753) and Gen. Pl. Ed. 5, 495 (1754).

A monotypic genus with characters of the species.

Cocos nucifera, L. Sp. Pl. Ed. 1, 1188 (1753); Cham. Remarks and Opinions, 146, 151, 152 (1821); Beechey, Voy. Pac. Ber. Str. 517 (1831); Doane, in Amer. Journ. Sci. lxxxi, 322 (1861); Kubary, Ethn. Beitr. Kenntn. Karol. Arch. 101-102 (1895); Engler, in Notizbl. Bot. Gart. Berlin, i, 223-224 (1897); Volkens, in Engler Bot. Jahrb. xxxi, 459 (1901); Safford, in Contr. U. S. Nat. Herb. ix, 233-243, pl. XLIII, XLIV (1905); Hattori, in Journ. Coll. Sci. Imp. Univ. Tokyo, xxvii (10), 45 (1908); Prowazek, Deut. Marianens, 114 (1913); Merr. in Phil. Journ. Sci. Bot. ix, 63 (1914); Koidzumi, in Bot. Mag. Tokyo, xxix, 247 (1915); Wils. in Jour.

Arnold Arb. i, 105, 109, 110 (1919); Grimble, in Journ. Roy. Anthrop. Inst. liv, 103 (1924); Kanehira, in Bot. Mag. Tokyo, xlv, 274 (1931), in Fl. Micr. 73-74 (1933), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 283 (1935), and in Journ. Jap. Bot. xii, 634 (1936); Anon., in Guam Recorder, xiii (8), 4-5, 30 (1936); Hosokawa, in Kudoa, v, 87 (1937), and in Bull. Biogeogr. Soc. Japan, vii, 184, 218-220 (1937); Tuyama, in Journ. Jap. Bot. xvii, 321 (1941); Riesenberg, in Southw. Anthrop. Journ. iv, 428 (1948); Bryan, in Guam Recorder, xvi (6), 38 (1939); Spoehr, in Fieldiana Anthrop. xxxix, 55-56 (1949) and xli, 35, 63, 78-79, 128 (1954); Taylor, Plants of Bikini, 169-170 (1950); Stone, in Atoll Res. Bull. v, 1-56, vi, 1-46 (1951); Glassman, in Bull. Bernice P. Bishop Mus. 209, 109-110 (1952), and in Pac. Sci. vii, 298, 301, 305 (1953); U. S. Navy, Hydrographic Office, Sailing Directions, Pac. Is. i, 338 (1952); Cloud, in Atoll Res. Bull. xii, 14 (1952); Luomala, in Bull. Bernice P. Bishop Mus. 213, 1-129 (1953); Hatheway, in Atoll Res. Bull. xvi, 1-68 (1953); Gressitt, in Atoll Res. Bull. xxi, 3 (1953), in Bernice P. Bishop Mus., Insects of Micronesia, i, 1-257 (1954); Fosberg, in Atoll Res. Bull. xxiii, 1-26 (1953), xxxviii, 1-36, xxxix, 6 (1954); Burrows and Spiro, An Atoll Culture, 42-48 (1953). Fig. 138.

The above is by no means a complete list of published works mentioning the coconut in Micronesia but it includes most of those of special botanical interest.

Trunks solitary, unarmed, often somewhat curved at the base, varying from dwarf in some forms to very tall: leaves pinnate, the pinnæ reduplicate in venation with a prominent midnerve, acute, numerous and evenly spaced in a single plane and usually arcuate-pendulous from either side of the stout rachis, base of stout petiole expanded into a fibrous sheath, semipersistent in the crown: inflorescence borne among the leaves, subtended by a short outer and subpersistent long, beaked, deeply striate, woody outer bract, the panicle simply branched with stout rachillæ bearing one or a few triads of 2 staminate and 1 pistillate flowers at the base, paired to solitary staminate flowers above: staminate flowers asymmetric, 12-15 mm. long, with 3 small imbricate acute sepals much exceeded by the ovate acute flat valvate petals, stamens 6 with erect filaments, anthers oblong, sagittate at base, more or less bifid at apex, pistillode short with 3 elongate processes; pistillate flowers subglobose much exceeding the staminate with imbricate rounded sepals and petals, staminodes united in a low disk-like ring at base of globose ovary: fruit very large, usually 25 cm. long or more with smooth exocarp, thick fibrous mesocarp and bony thick endocarp, bearing 3 pores at the base and tightly adherent to the seed, endosperm homogeneous, becoming firm at length with a hollow center, embryo opposite one of the pores.

138. Cocos NUCIFERA, commonly planted in Micronesia.

Marianas Islands. Pagan I., *L. D. Bonham 25* (US), *G. W. Corwin PC-79-6* (fossil) (US).

Caroline Islands. Yap I.: Dugue, Okau, March 4, 1948, *C. Y. Wong 551* (US). Kapingamarangi Atoll, Hare I., August 3, 1946, *Fosberg 26084* (US, BH).

Marshall Islands. Jemo I., December 1951, *Fosberg 33899* (US). Eniwetok Atoll, Igurin I., May 14, 1946, *Fosberg 24316* (US, BH, BISH).

Gilbert Islands. Onotoa Atoll, 1951, *E. T. Moul 8363* (US).

The cited specimens give no idea at all of the distribution. This species is by far the commonest palm in Micronesia, planted on all islands except uninhabited Pokak in the Marshalls (where at least one young plant existed in 1943 but by 1952 had disappeared) and Uracas, in the Marianas, which has been denuded by recent volcanic activity. On Saipan, Tinian and Rota these palms were formerly abundant but were in the 1940's completely killed out by the beetle, *Brontispa mariana*, which bores in the terminal bud. Since 1950 there has been some replanting.

This palm is the mainstay of the island economy and one of the most important sources of food to the indigenous people. The dried flesh of the nuts, called copra, is the principal item of export and is the source of the coconut oil used in the manufacture of soap and oleomargarine.

Large plantations did not exist before the late 19th century, but small groves in the vicinity of native villages were very common. In the interior of southern Guam groves of coconuts and clumps of bamboo in the remotest uninhabited valleys give a clue to the dense population inhabiting these areas in pre-Spanish times. Search in these places reveals an abundance of broken pottery and stone implements.

The demand for copra initiated by the German trading companies in the late 19th century brought about such an expansion of coconut planting as to change the very character of the landscape, especially on the coral atolls. Now coconut groves and plantations are generally regarded as the characteristic feature of atoll vegetation.

A fossil occurrence was recently found on Pagan Island, northern Marianas, buried by a relatively recent eruption. It was found in association with *Alocasia macrorrhiza*. Both of these species are commonly regarded as distributed by man in the oceanic Pacific Islands, and their occurrence together strengthens the suggestion that they were brought there by the aborigines within the last 4000 years. Pagan is one of the places where apparently wild coconuts are now found. The island supported a large human population before the conquest by the Spanish and present wild stands probably date from this period.

The question of whether the coconut is truly indigenous in Micronesia is one that cannot be settled definitely. In most places it has every appearance of having been planted or growing spontaneously as progeny of planted trees. A few germinated drift coconuts have been seen in the Marshall Islands (Fosberg), but not on islands where planted trees did not exist.

NYPA, Wurmb, in Verh. Batav. Gen. i, 349 (1779); Burret, in Notizbl. Bot. Gart. Berlin, xv, 93 (1940); Safford, in Contr. U. S. Nat. Herb. ix, 334 (1905).

A monotypic genus with characters of the species.

Nypa fruticans, Wurmb, op. cit. 350; Volkens, in Engler Bot. Jahrb. xxxi, 459 (1901); Safford, in Contr. U. S. Nat. Herb. ix, 335 (1905); Merr., in Phil. Journ. Sci. Bot. ix, 64 (1914); Kanehira, in Bot. Mag. Tokyo, xlv, 273 (1931), in Journ. Dept. Agr. Kyushu Imp. Univ. iv, 284 (1935), in Journ. Jap. Bot. xii, 635 (1936); Hosokawa, in Kagaku V, v, 498 (1935), in Kudoa, v, 87 (1937), in Bull. Biogeogr. Soc. Japan, vii, 184 (1937); Bryan, in Guam Recorder, xvi (6), 38 (1939); Tuyama, in Journ. Jap. Bot. xvii, 321 (1941); Fosberg, in Journ. N. Y. Bot. Gard. xlviii, 128-138 (1947).

Stem mostly subterranean, spongy-pithy, to 50 cm. thick, usually less: leaves strongly ascending to erect, arching distally, up to 6-7 m. tall, petiole terete above a short open sheathing base, in a leaf 3 m. long the petiole 30 cm. long, the rachis 225 cm. long, with 42 pairs of more or less equidistant mostly alternate ascending pinnæ 3-3.5 cm. apart, pinnæ linear, attenuate to a narrowly acute to long-attenuate tip, the basal pinnæ much smaller, median 173 cm. long, 6.3 cm. wide, apical smaller; leaves glabrous except for a scattered row of linear fimbriate-margined scales 2-3.5 cm. long, attached by the middle to under side of midrib, midrib and marginal vein very heavy, midrib strongly keeled above, 2 secondary ones on either side, fine nerves relatively coarse, numerous: inflorescences arising from axils of leaves, erect, to 75 cm. high at maturity, less at staminate anthesis, peduncle and main axis sheathed by tubular bracts with spathe-like blades, each of these bearing in its axil a primary branch, this however so completely adnate to the internode above that it appears a part of the internode except for a line that is decurrent downward from each side of the place where the branch actually separates which is at the first node of the branch and just below the next node of the main axis, the 4 distichously arranged primary branches similar in arrangement to the whole panicle, but curved outward, each bearing about 2 secondary branches, each of which again bears similarly 1 branch, all of these and the terminal ones sheathed by a diminishing series of tubular spathiform bracts, each final vegetative ramification except the central one of the panicle bearing a series of 1-5 successive bracteate staminate spikes, these about the size and shape of man's little finger, the central terminal axis bearing a head of pistillate flowers subtended by a series of 8 or more diminishing imbricate bracts: staminate flowers radiating perpendicularly from the

rachis, densely crowded, subtended by subulate bractlets and consisting of an outer and an inner series of cuneate-oblanceolate perianth-segments about 3 mm. long, the outer obtusish or rounded at the apex, the inner slightly prolonged into a blunt point, the 3 stamens fused into a column of which the filaments are about 2-2.5 mm. long, the anthers about 2 mm. long, oblong basifixed, connate by their connectives, extreme tips of the cells free, cells dehiscing by longitudinal slits, pistillode lacking; pistillate flowers with 6 vestigial erect scale-like perianth-segments, without staminodes, the 3 carpels with a narrow ovary at the base containing a single erect ovule, a stylar portion greatly enlarged, up to 1.5 cm. high and 1 cm. in greatest width, obpyramidal, strongly angled through crowding together in the head, apex asymmetric, umbonate to one side, umbo bearing the two-lipped pit-like stigma: fruits crowded in a globose mass 15-20 cm. in diameter, 2-4-angled and ridged by compression, obovoid to obcordate, stipitate, 9-10 cm. long, including 2 cm. of stipe, 5-6 cm. least width, 7-8 cm. greatest width, exocarp smooth, irregularly longitudinally ribbed, mesocarp thick, spongy and fibrous with longitudinal fibers, endocarp dense, bone-like, adherent to seed, with a longitudinal intrusion almost 1 cm. into the cell to which the seed is attached laterally, at base below seed is a cylindric cavity, 1.5 cm. deep and 5 mm. wide, somewhat dilated below middle, then drawn down to a point; seed large, reniform in cross-section, invaginate along attachment, oval, slightly compressed, 4.5 cm. high, 4.6 cm. wide, 3.6 cm. thick, seed-coat rough, filled with strong vascular fibers ascending from base interlocking and anastomosing toward apex, endocarp hard, homogeneous, embryo basal, upon germination growing down through cavity beneath it.

Caroline Islands. Kusaie: Lela Island, swamp near ruins of ancient temple, 1-5 m., August 19-21, 1946, *Fosberg 26536* (BH, US). Truk Group: Ulalu (Romonum), October 2, 1947, *C. Y. Wong 155* (US). Yap: Ngoluk, Rul, February 17, 1948, *C. Y. Wong 462* (US). Palau Group: Babeldaob Island, Marikyoku (Melekiok), July 18, 1929, *Kanehira 451* (FU); Koror Island, March 14-15, 1950, *Fosberg 32112* (BH, US). West side of s.w. peninsula of Urukthapel Island, near old cultured pearl establishment, March 17-19, 1950, *Fosberg 32162* (BH, US).

Marianas Islands. Guam: Inarajan River, May 7, 1936, *Bryan 1277* (US); Mouth of Ylig River, November 13, 1945, *Rodin 777* (US).

Vernacular names are: "Towe'el," Palau, acc. Alkong; "Ang," Yap, acc. Wong; "Kyywa," Truk, acc. Wong; "Faasha," Kusaie, acc. Fosberg; "Nipa," Guam, acc. Safford.

Nypa is common generally along the shore of estuaries, in tidally inundated areas and to some extent in mangrove swamps in Palau, Yap, Truk, Ponape, Kusaie, and Guam. Safford (1905) says it "was introduced into Guam from the Philippines for the sake of its leaves which make excellent thatch. It has established itself at the mouth of nearly every stream in the island where the water becomes brackish. . . ." He says

that the leaves were used for thatching the better homes of the island. This is no longer true and it is little if any used for this purpose. Also it no longer grows in any quantity on the west side of the island, because of military activity, but is still conspicuous along streams on the east side.

CULTIVATED PALMS

Many genera of palms have been introduced, principally by the Japanese at the Experiment Station on Ponape and by various agencies on Guam. The following list includes those known from actual collections or from the following sources in the literature:

Ashizawa, The plant relocation survey, 1-4, 1-26, 1-3, Tokyo (1954) mimeographed.

Bryan, in Guam Recorder, xvi, (6), 22-23, 38 (1939).

Glassman, Tentative list of plants at Agricultural Station, Ponape 1-4, Ponape (1949) mimeographed.

Hosino, List of plants in cultivation Ponape Branch Office, Tropical Industrial Investigation (manuscript dated 1945 in Pacific Vegetation Project files).

Merrill, in Phil. Journ. Sci. Bot. ix, 17-155 (1914).

Safford, in Contr. U.S. Nat. Herb. ix, 1-416 (1905).

In case of species that have been discussed in articles in earlier issues of Gentes Herbarum, the volume and pages where such discussion may be found are inserted in parentheses.

Adonidia Merrillii, (Becc.) Becc.—Guam, Umatac, *Fosberg 35446* (BH, US).
Areca Cathecu L.—Ponape (see page 449). (cf. Gent. Herb. iii, 435).
Arenga Engleri, Becc.—Ponape.
Arenga pinnata, (Wurmb) Merr. [*A. saccharifera,* Labill.]—Guam, Palau, Ponape.

Calamus spp.—Guam, Palau, Ponape.
Caryota mitis, Lour.—Palau: Korror, Ngleaklolubed, site of old Japanese botanical garden, *Fosberg 32389* (BH, US); Ponape.
Caryota urens, L.—Ponape.
Chrysalidocarpus lutescens, Wendl.—Ponape.
Cyrtostachys lakka, Becc.—Ponape.

Dictyosperma album, (Bory) Wendl. & Drude ex Scheffer—Guam (cf. Gent. Herb. vi, 93-94).
Didymosperma porphyrocarpum, (Blume ex Mart.) Wendl. & Drude ex Michaels—Palau: Korror, Ngleaklolubed, site of old Japanese botanical garden, *Fosberg 32333* (BH, US).

Elæis guineensis, Jacq.—Palau, Ponape, Truk.

Howeia Forsteriana, (Moore & Mueller) Becc.—Ponape (cf. Gent. Herb. iv, 195-198).

Latania borbonica, Lam. [*L. Commersonii,* Gmel.]—Ponape (cf. Gent. Herb. vi, 62-65).
Latania Loddigesii, Mart.—Guam, Ponape (cf. Gent. Herb. vi, 61-62).
Livistona chinensis var. **subglobosa,** (Hassk.) Becc.—Guam (see page 433).
Livistona rotundifolia, (Lam.) Mart. [*L. altissima,* Zoll.]—Ponape.

Mascarena lagenicaulis, Bailey [*Hyophorbe amaricaulis,* Hort.]—Ponape (cf. Gent. Herb. vi, 74-76).
Mascarena Verschaffeltii, (Wendl.) Bailey—Ponape (cf. Gent. Herb. vi, 76-78).
Metroxylon amicarum, (Wendl.) Becc.—Guam (see p. 439).
Metroxylon Rumphii, (Willd.) Mart.—Palau.
Metroxylon Sagu, Rottb.—Palau, Ponape.

Phœnix canariensis, Hort. ex Chabaud—Ponape.
Phœnix dactylifera, L.—Guam, Ponape.
Phœnix Roebelenii, O'Brien—Ponape.
Pritchardia pacifica, Seem. & Wendl.—Marshall Islands: Ailinglapalap Atoll, *Lyman & Wong 83* (BH, US). Caroline Islands: Ponape; Colonia, *Kanehira 878* (FU) (cf. Gent. Herb. iii, 115).
Ptychosperma Macarthuri, (Wendl. ex Moore) Nichols. [*Actinophlœus Macarthuri,* (Wendl. ex Moore) Becc.]—Ponape.

Raphia vinifera, P. Beauv.—Ponape.
Rhapis excelsa (Thunb.) Henry ex Rehd. [*R. flabelliformis,* L' Hér. ex Ait.]—Ponape (cf. Gent. Herb. iv, 202-206).
Rhapis humilis, Blume—Ponape (cf. Gent. Herb. iv, 206-207).
Roystonea elata, (Bartram) Harper—Ponape, Palau (cf. Gent. Herb. iii, 370-375; viii, 128).

Sabal minor, (Jacq.) Pers. [*S. Adansonii,* Guersent]—Guam (cf. Gent. Herb. vi, 386-393).
Sabal Palmetto, (Walt.) Lodd. ex Schult. & Schult.—Ponape (cf. Gent. Herb. vi, 432-434).
Sabal umbraculifera, Mart. [*S. Blackburnia,* Glazebr. *S. Blackburniana,* Hort.]—Ponape (cf. Gent. Herb. vi, 437-442).
Salacca edulis, Reinw.—Ponape.

Trachycarpus Fortunei, (Hook.) Wendl.—Ponape (cf. Gent. Herb. ii, 191-192).

Wallichia disticha, T. Anders.—Ponape. Material cultivated under this name frequently proves to be a species of Arenga.